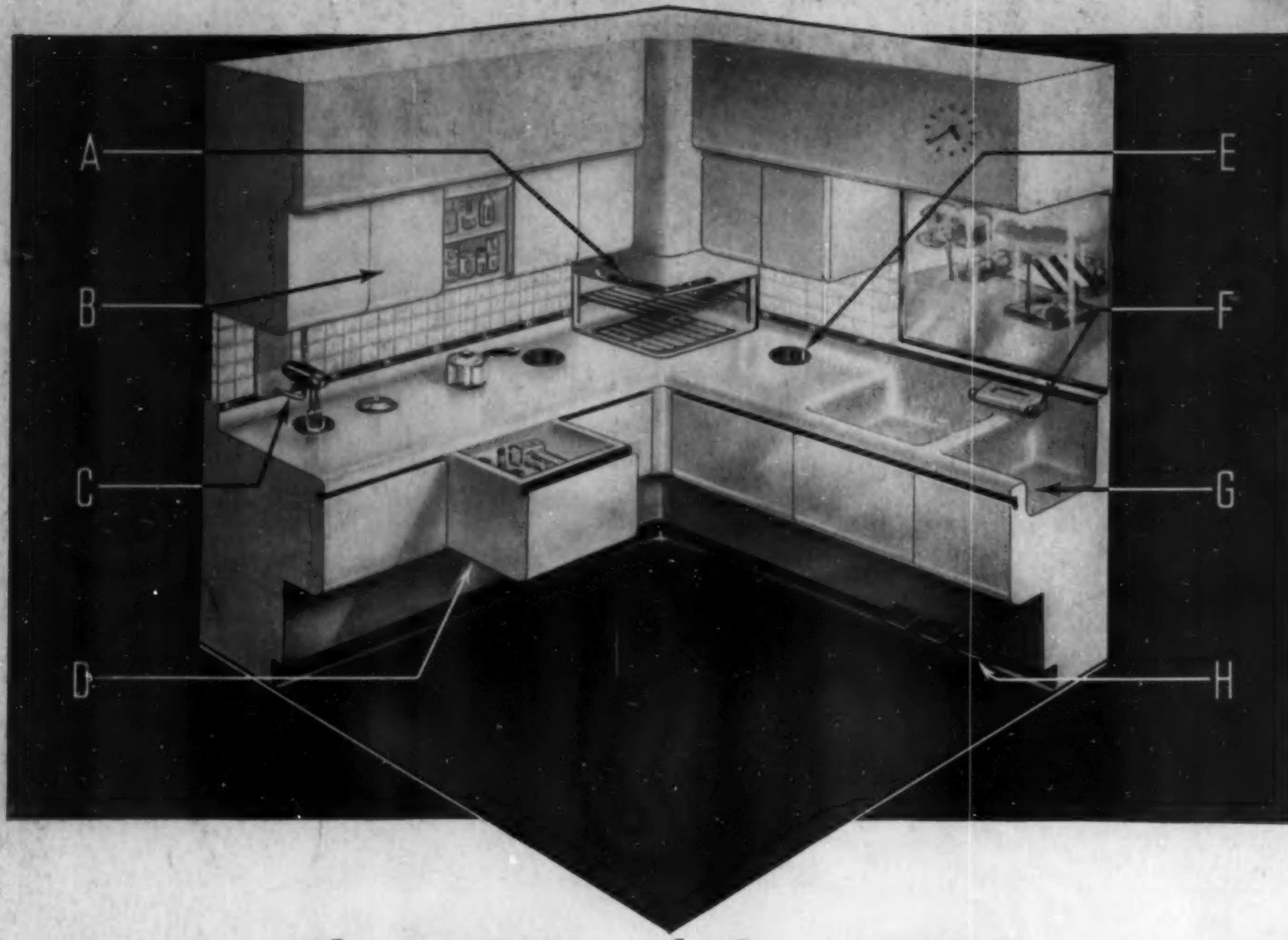
MODERN PLASTICS

mp

DECEMBER 1942



The A-B-C's of the Future!

WE WOULDN'T KNOW for sure, but it's our guess that apple pie "like mother used to make" will still be No. 1 on the hit parade with the men of *tomorrow*.

But one thing we are certain of . . . Durez phenolic plastics and resins are going to make some startling innovations and improvements in the American conception of the kitchen! Yet it isn't necessary to take our word for it! Listen, rather, to Mr. Reinecke, who designs before he speaks:

"There is no limit to my personal enthusiasm for Durez phenolic plastics and resins. Their heat resistance and dielectric strength make them the logical material for the kitchen I have visualized here. Their smooth, lustrous and colorful finish naturally appeals to the style-conscious American woman. Their mass-production economies and precision-molding characteristics find ready acceptance with manufacturers. Actually, their properties are so well developed that this future kitchen could be built today!"

We don't have to tell you why Durez plastics and resins are not being used to build such kitchens today. Like every other American industrial product, they're being fed to the production lines of our arsenals. But when victory is ours . . . among the multitude of plastic products you'll be buying, here's the a-b-c of *your* new kitchen!

J. O. REINECKE,
Industrial Designer

A. Sliding Durez plastic door of table-height broiler-oven. Door slides upward to prevent heat loss.

B. Walls, cabinet doors, work top and drawers of Durez resin-bonded plywood.

C. Electric appliances move directly into place above work top and electric plates.

D. Open-top refrigerator drawers reduce loss of cold air. Drawers spaced at various points around the kitchen; temperatures controlled for articles used at each station.

E. Electric plates and sunken cooking utensils with Durez plastic handles to be located at advantageous points, instead of being grouped as on present-day stoves.

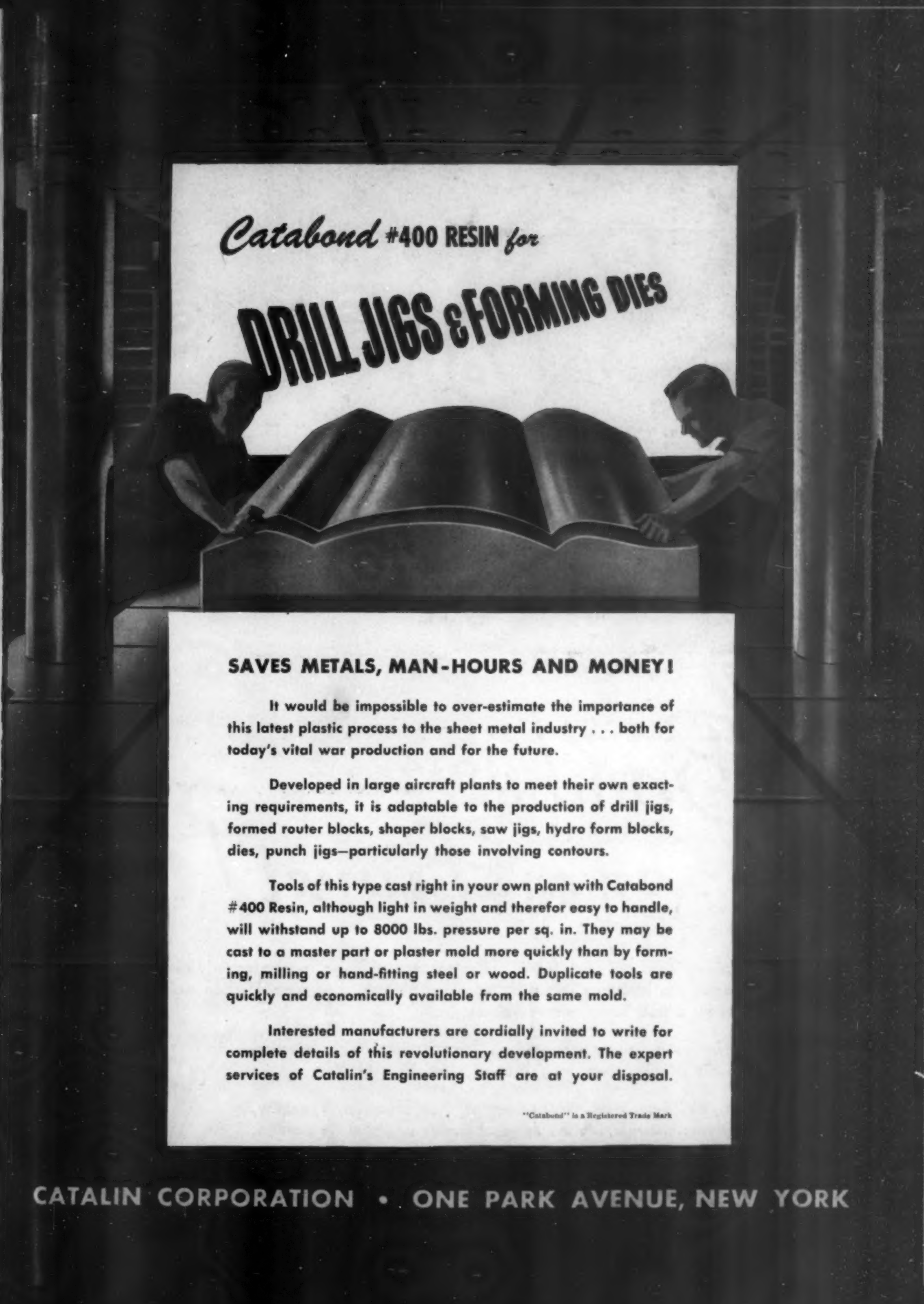
F. Plumbing fixtures to be finished in Durez plastics and have plastic controls.

G. Light-weight Durez plastic sink. Finish cannot chip, stain or mar as it goes all the way through the molded piece.

H. Water and drain controls are foot-operated by means of Durez plastic pedals.

DUREZ . . . plastics that fit the job

DUREZ PLASTICS & CHEMICALS, INC. DUREZ 1132 WALCK ROAD, N. TONAWANDA, N. Y.


Catabond #400 RESIN for
DRILL JIGS & FORMING DIES
SAVES METALS, MAN-HOURS AND MONEY!
It would be impossible to over-estimate the importance of this latest plastic process to the sheet metal industry . . . both for today's vital war production and for the future.
Developed in large aircraft plants to meet their own exacting requirements, it is adaptable to the production of drill jigs, formed router blocks, shaper blocks, saw jigs, hydro form blocks, dies, punch jigs—particularly those involving contours.
Tools of this type cast right in your own plant with Catabond #400 Resin, although light in weight and therefor easy to handle, will withstand up to 8000 lbs. pressure per sq. in. They may be cast to a master part or plaster mold more quickly than by forming, milling or hand-fitting steel or wood. Duplicate tools are quickly and economically available from the same mold.
Interested manufacturers are cordially invited to write for complete details of this revolutionary development. The expert services of Catalin's Engineering Staff are at your disposal.
"Catabond" is a Registered Trade Mark
CATALIN CORPORATION • ONE PARK AVENUE, NEW YORK

That Bombs may Burst!

Bombs, tanks, guns, and planes need our vital metals. Replacement of these metals, formerly required for essential civilian use, in many instances can best be effected by the use of plastics. Energetic injection molders are daily developing plastic substitutes for articles formerly made of metal.

A typical example is the bathroom fixtures produced on Reed-Prentice Plastic Injection Molding Machines by Plastic Molded Arts, Inc., of Long Island City, N. Y.

Reed-Prentice 4-oz., 6-oz., and 8-oz. machines, because of their precision, versatility, and adaptability to new plastic materials, are the universal choice of aggressive molders.

ARMY E NAVY

REED-PRENTICE CORPORATION 1213 W. 3d St., CLEVELAND, OHIO
75 WEST ST., NEW YORK CITY

WORCESTER, MASSACHUSETTS, U. S. A.

modern plastics

INCLUDING

Plastics ENGINEERING

DECEMBER 1942

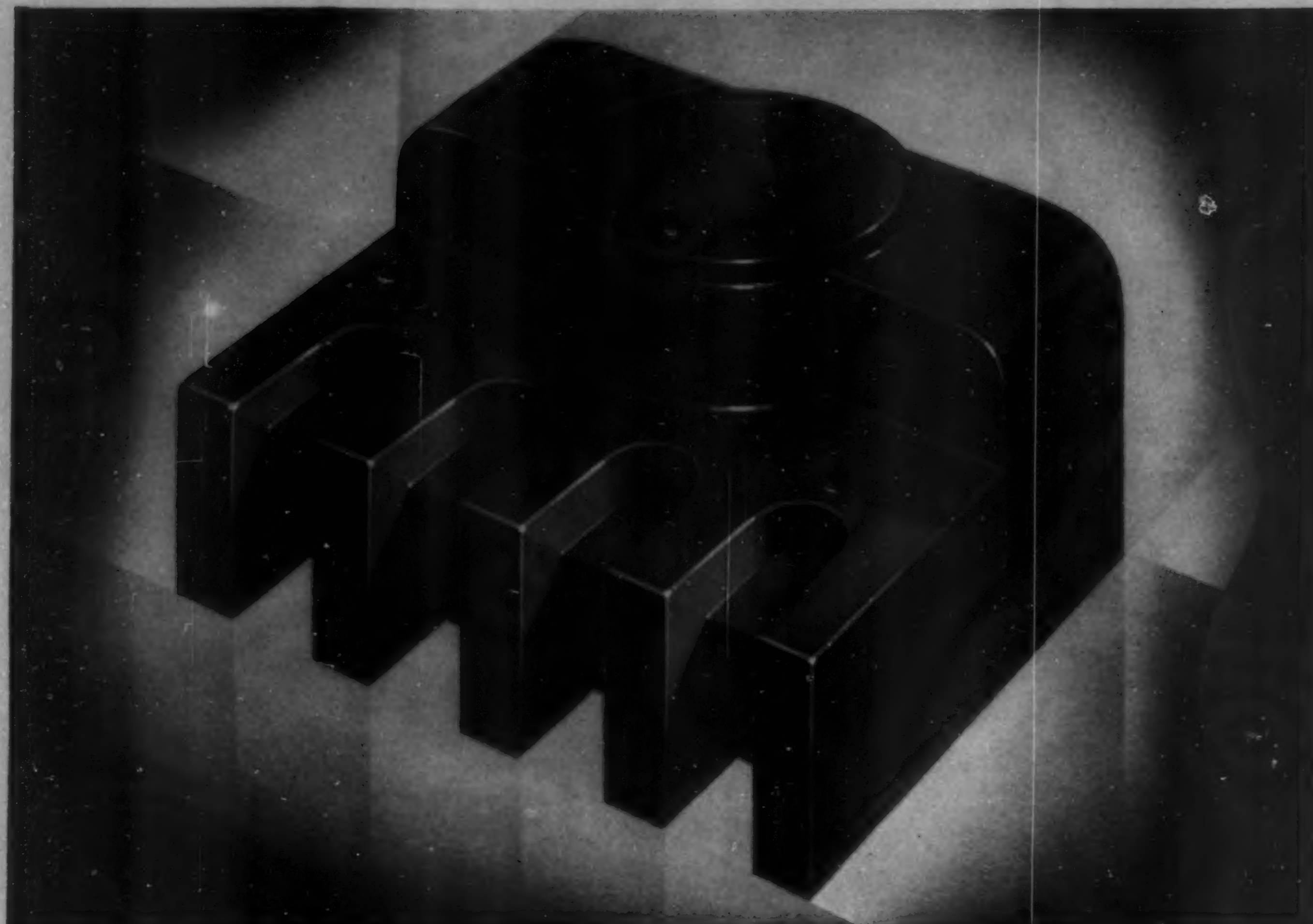
VOLUME 20 NUMBER 4

• GENERAL INTEREST

• PLASTICS ENGINEERING

• TECHNICAL SECTION

• NEWS AND FEATURES



How they simplified the "Life of Inspector Riley"

ONCE he was known as *rejector* Riley and that meant trouble—trouble for him—shut-down on the assembly line—and slow-down of the company's war effort.

But that was before Richardson Plasticians and the contractor's engineers started working together—before the part was made of Molded INSUROK.

In hundreds of ways, Richardson Plasticians have helped scores of manufacturers win acceptance and enthusiastic approval for their war products and parts. And INSUROK Precision Plastics have been the means of successfully meeting many a tough specification—of speeding up production that might otherwise be delayed.

If you have a problem which molded or laminated plastics might solve—or a plastics fabrication problem on which years of experience might be beneficial, write us.

The Richardson Company, Melrose Park, Illinois; Lockland, Ohio; New Brunswick, New Jersey; Indianapolis, Indiana. Sales Offices: 75 West Street, New York City; G. M. Building, Detroit, Michigan.

INSUROK and the experience of Richardson Plasticians are helping war products producers by:

INSUR

MADE AND SOLD ONLY BY THE RICH

Write these

IN YOUR TELEPHONE INDEX

When the telephone company answers a request for more trunks with an argument that you are sitting pretty as you are and don't need anything done to your system, you know things are tough all along the line.

We did manage to wangle a couple of internal extensions to take care of new and expanding departments and a new number—**BOONTON 8-2020.** We never did like the old one. This sort of trips over your tongue and is easy to remember.

For some time we've had a New York City line direct to the factory. For a single nickel in the slot you can dial **LONGACRE 5-4097.** It doesn't sound so euphonious, but what do you care if you save a quarter? You get the factory and spill all your troubles.

Then, of course, there is the New York office itself, **MURRAY HILL 6-8540.** It's really a mighty nice layout in room 1716, Chanin Building, corner of Lexington Avenue and 42nd St. Not only a lot of things to see, nicely displayed, but staffed by people who can really answer your questions because they know how, after at least fifteen years' hard experience with us.

All to make it easy for you to walk into our web and like it.

"A Ready Reference for Plastics" written for the layman, is now in a new edition. If you are a user or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics. Free to business firms and government services.

ARMY E NAVY

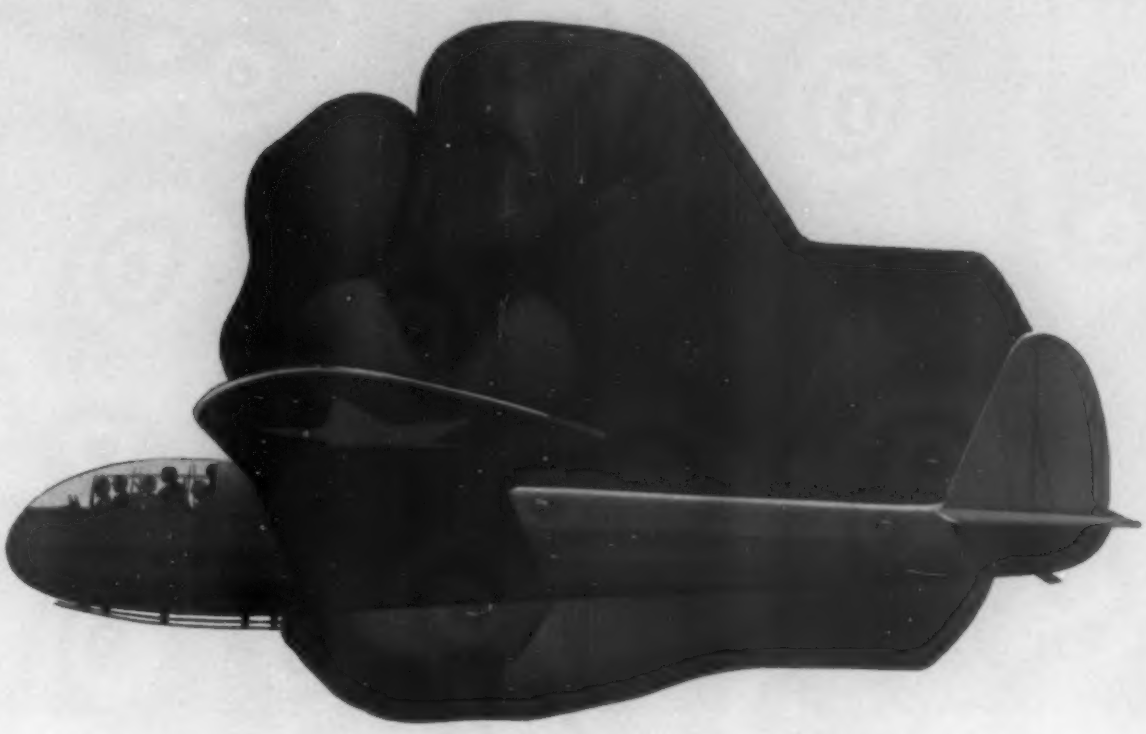
BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-0991

N. Y. Office—Chanin Bldg., 122 East 42nd Street, Murray Hill 6-8540

QUALIFICATIONS FOR GLIDER PILOT TRAINING 1. Men between the ages of 18 to 35 inclusive, holding a currently effective C. A. A. Airman's Certificate, private grade, or higher. 2. Or, holding a C. A. A. Airman's Certificate, private grade or higher, that has lapsed since January 1, 1941. 3. Or, a certified statement showing completion of 200 or more glider flights. 4. Or, if you are a former aviation cadet or aviation student, who has completed at least 50 hours of total flying time, either dual or solo, at any Army, Navy or other service flying school. . . . . *Get in touch with your nearest recruiting office.*



IMPACT STRENGTH!

Out of the silent skies will come shock-invasions of the Winged Commandos. These swift-gliding champions will hurl their impact strength when and where the enemy is least prepared.

Impact strength rides with them in their gliders. Aero-Quality Lumarith is used in cockpit enclosures, windshields and ports. Lumarith Molding Materials are used for many other vital glider and 'plane parts. The impact strength of these super-tough plastics—even at the low temperatures of high altitudes—is greater, in some cases, than the strength of other plastics at room temperatures.

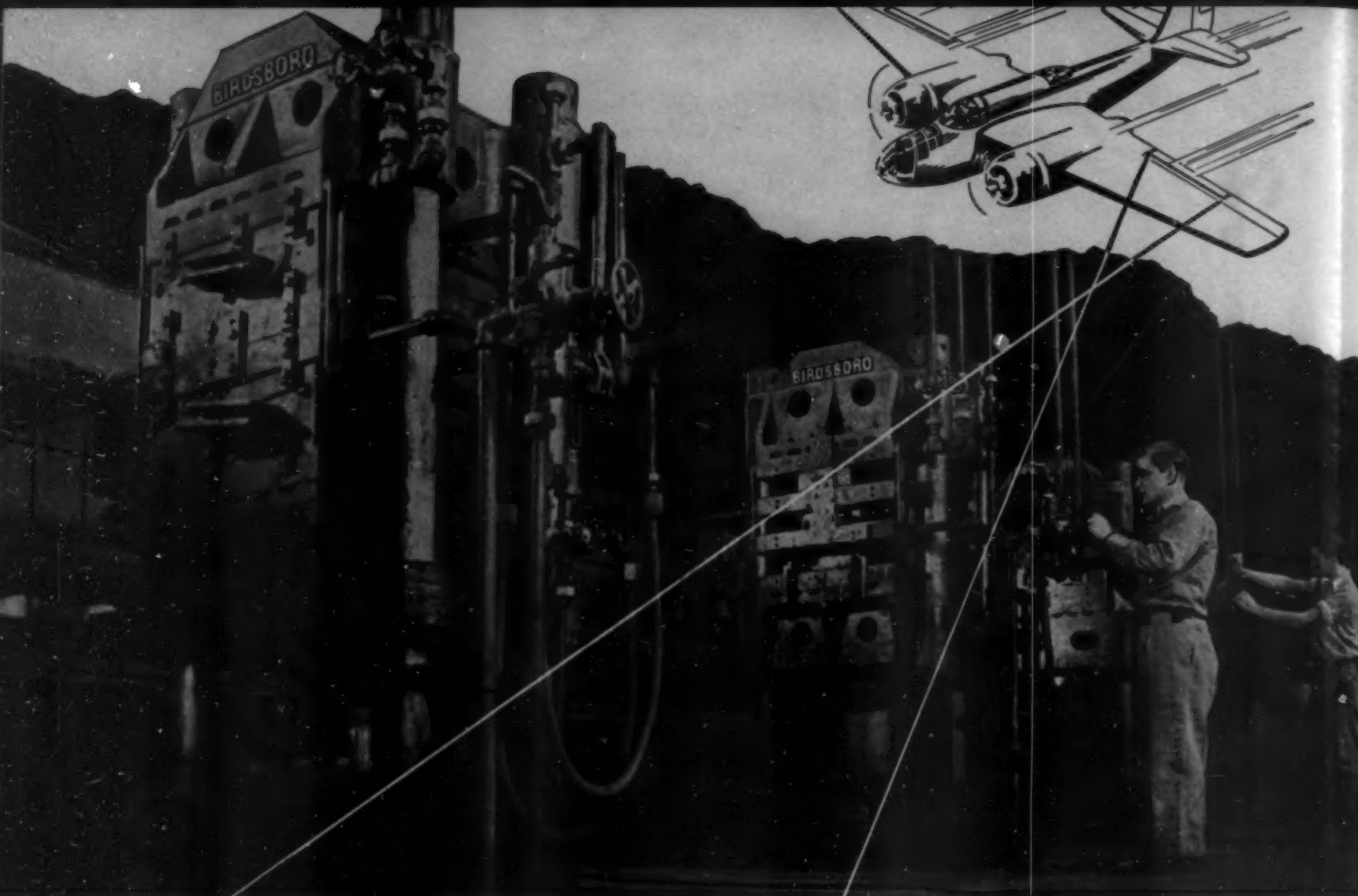
LUMARITH

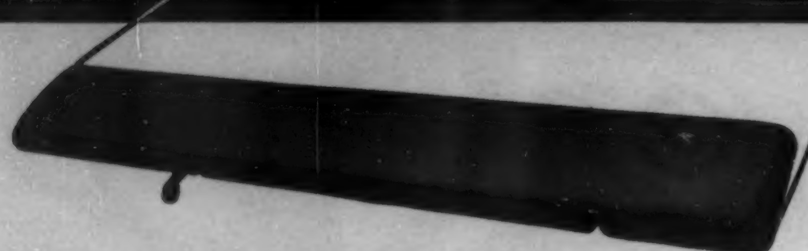
One of the lightest and most transparent plastics known, Lumarith is shatterproof. It speeds production because it is easy to form—simple curves can be formed without heat. Lumarith resists crazing. It is impervious to water and has excellent weathering qualities.

Celanese Celluloid Corporation, 180 Madison Ave., New York City, a division of Celanese Corporation of America Sole Producer of Celluloid* (cellulose nitrate plastics, film base and dopes) . . . Lumarith* (cellulose acetate plastics, film base, insulating, laminating and transparent packaging material and dopes) . . . Lumarith* E. C. (ethyl cellulose molding materials) . . . ****Trademarks Reg. U. S. Pat. Off.*
Representatives: **Dayton, Chicago, St. Louis, Detroit, San Francisco, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto.**

CELANESE CELLULOID CORPORATION

The First Name in Plastics





Helping to "work miracles" with laminated plastics, these Birdsboro Presses at the Taylor Fibre Company, are turning out airplane parts 24 hours a day.

PHOTOGRAPH COURTESY OF
LION GRINDING WHEELS, LTD.

GRINDING
Its Way to VICTORY

Months ago, we realized the need for increased production of grinding wheels and expanded our facilities for the development and production of our resins to assist in the all-out war effort.

Today, with our enlarged Niagara Falls plant in such a central geographical location, shipments ranging from a single drum to a carload can quickly be made.

It's strange to think of Phenolic Resins as a weapon of war... but it is a vital contribution to manufacturers of grinding wheels... without which the vast production programs of today would fail. As a Resin bond for abrasive wheels, Varcum has developed Resins with higher tensile strength, Resins with longer flowing characteristics and, in all types, an unvarying uniformity which gives added assurance in dealing with the diversified grinding problems of today.

VARCUM CHEMICAL CORPORATION

Manufacturers of Outstanding Resins

NIAGARA FALLS, N. Y.

We're doing our Fall plowing now

Up here in Central New York we're probably a little closer to the country than a lot of you. As we write this ad we can look up to the hills where a farmer with a three-horse hitch is turning long, dark furrows across a field.

He's doing his Fall plowing.

As we pull our eyes back to our desk, we again become conscious of the rumble of the presses in the plant, where twenty-four hour production isn't enough. Right here we begin to realize that we, right now, are doing our Fall plowing.

We're turning out molded plastic parts for all kinds of instruments to be used against our enemies. Our presses are spilling them out by the millions. We're working night and day. Right now we couldn't make you a radio case, or a refrigerator door handle, or an ash tray.

The Winter of this war may be long, hard and bitter, but the experience that we are plowing under today adds to our 66 years of pioneering and will help us make better plastic parts for you in the Spring of Peace.

MOLDED PLASTICS DIVISION

AUBURN BUTTON WORKS

AUBURN, N. Y.

Holidays, and even holy days, seem remote and almost unimportant as we fight our first total war. And yet, to neglect the spirit of Christmas in this year of war 1942, would be not only sacrilegious but contrary to the very things for which we all strive, fight, and die.

We wish our friends, our good neighbors and our allies well this Christmas, and we offer them our most heartfelt desire for peace and good will. May this be the last Christmas ever to be celebrated by Americans during a war.

C L Cruver   Chas. C. [illegible]

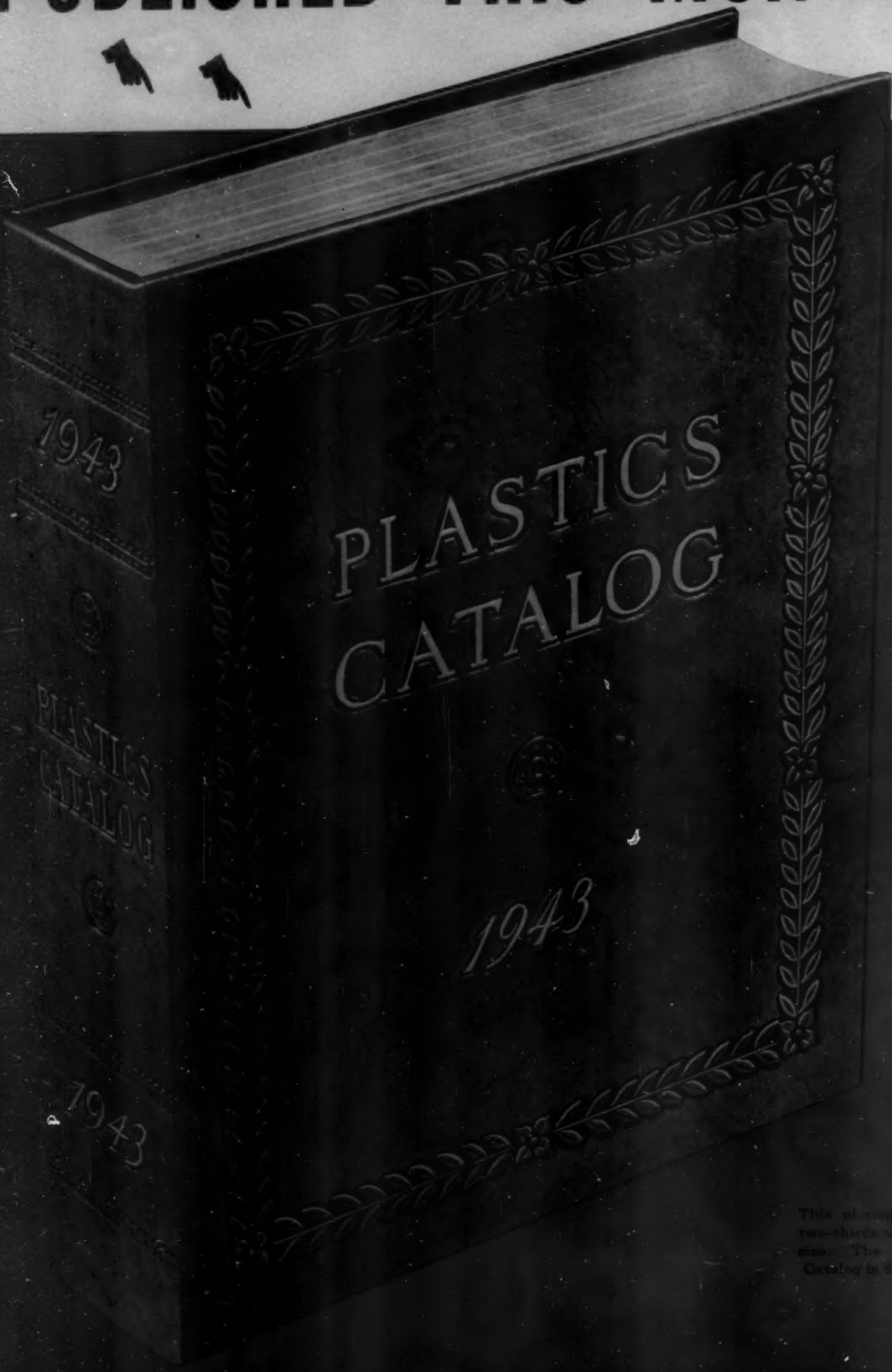
for the

Cruver Mfg. Co.

2456 W. JACKSON BLVD.

CHICAGO. ILLINOIS

PUBLISHED THIS MONTH



This photograph is two-thirds of actual size. The Plastics Catalog is [illegible]" x 12".

Largest Plastics Catalog EVER PRINTED

THE YEARBOOK OF THE PLASTICS WORLD COMES OFF THE PRESSES THIS MONTH!

The 1943 Plastics Catalog will be the largest (864 pages) ever published. It has been much expanded to include all the new applications of plastics, the new materials developed for commercial application during the past year, and the new molding and manufacturing techniques. It has been completely re-written, and new photographs and diagrams illustrate the text.

Such timely subjects as Synthetic Rubbers and Plastics in War receive greatly expanded treatment in this new book. A special chart of the properties of Synthetic Rubbers will be included in that section; and both the size and number of articles will be enlarged.

PLASTICS IN WAR

The section on Plastics in War will cover every branch, every arm and every department of the U. S. Government having any relationship with the plastics industry. A separate chapter will be devoted to each of these bureaus, and all offices maintaining procurement contacts with the plastics field will be listed. Applications of plastics in war will be described and pictured.

TWO NEW CHARTS

Besides the Synthetic Rubbers Chart, there will be another completely new table in the 1943 Plastics Catalog. This will be entitled the Chemical Formulae of Synthetic Resins and Rubbers and will detail the complex character of each material, in standard technical form, in easily referable tabular layout.

Every section of the book has been analyzed by experts in particular subjects, has been re-edited and re-written. Illustrative material is new and up-to-date throughout. The standard Charts, Plastic Properties, Plasticizers and Solvents, will be expanded to include new data and new materials.

Orders at the special pre-publication price of $3 per copy can be taken only up to and including December 15, 1942. After that time, the price will be $5 per copy.

☆ ☆ ☆

PLASTICS CATALOGUE CORP.

122 East 42nd Street **New York City**

KEEP UP WITH *YOUR BUSINESS*

PERSONNEL

A1a

PRIORITIES

PRODUCTION

VISIrecord

The plastics industry is making rapid strides. It is achieving new successes daily. It is growing in scope, in invested capital, and in personnel . . .

DON'T KEEP IT BACK WITH OBSOLETE RECORD-KEEPING EQUIPMENT

Give your accounting department the inspiring support of equipment with such consummate visibility that it cannot be mentioned in the same breath with other so-called visible systems.

PURCHASE

KEEP A DATE WITH A *VISIrecord* REPRESENTATIVE

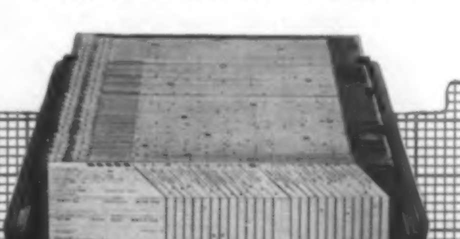
and learn first-hand, without obligation of course, what true, efficient, visible record-keeping means.

*VISI*record, "The World's Fastest Visible Record Keeping System," costs one-third to one-half less to install and to operate. It requires half the labor and half the space of other equipment. It functions equally well with hand or machine posting, and permits the operator to do the job on desk level! Its most amazing feature, however, is the exclusive 3 visible margins on the cards or forms —horizontal, diagonal and vertical—which makes for quick identification, and turns tedious entry-making into an incentive for record-keeping perfection.

STORES

Set a date now. Write for Booklet 44, "Keep These Vital Records Up to the Minute."

VISIBLE INDEX CORPORATION
535 FIFTH AVENUE • NEW YORK, N. Y.
OFFICES IN PRINCIPAL CITIES



MACHINE POSTED RECORDS

May I give you some information about Kys-ite?

I'm here to answer any questions you may want to ask about KYS-ITE. If you have never heard about this new wonder plastic, just wait a moment and I'll give you a demonstration. Won't you step this way, please?

Just Out. KYS-ITE is not a molding compound. It's a new miracle plastic, molded from strong pulp fibre and synthetic resin—and good news! It can be preformed to shape before curing.

It's Versatile. It can be used for trays, business machines, refrigerators, radios, batteries and scores of other things. It's even been used to replace light metal machine parts!

It's Tough. If that look on my face doesn't give you the idea, this fact will; KYS-ITE has four to five times the impact strength of ordinary plastics—yet weighs only half as much as aluminum!

It's Washable. It's practically non-absorbent. Alcohol, greases and mild alkalies can't stain it. Even boiling it in soaps, salts and acids failed to warp or disfigure it.

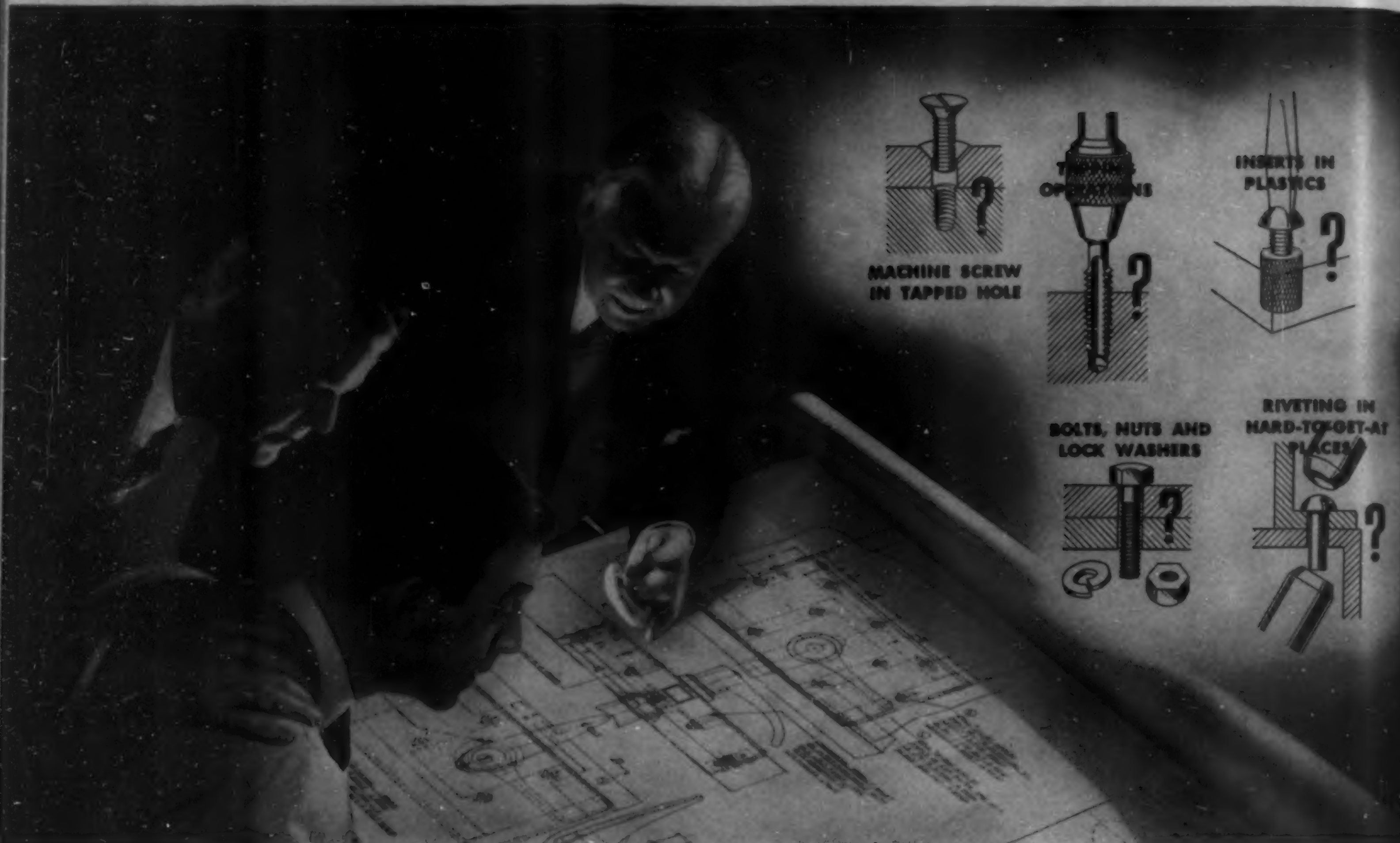
It's Quiet. Manufacturers launching an anti-noise campaign will find KYS-ITE ideal. It's non-resonant and non-reverberating. That means noise and clatter are eliminated.

It's Beautiful. This new plastic always inspires a lot of oh's and ah's because it's a real beauty winner. It's available in a wide range of rich, sparkling colors with real eye-appeal.

• LET KYS-ITE MOLD YOUR FUTURE •

KEYES FIBRE COMPANY, WATERVILLE, MAINE

Question every fastening job...



Wherever You Can Use P-K Self-tapping Screws You Can Save Time-Consuming Operations!

It has never been claimed that Parker-Kalon Self-tapping Screws offer the best means of making EVERY fastening under ALL conditions . . . BUT, it is a fact that, *for a very large percentage of metal and plastic fastening jobs, these famous screws offer a combination of ease, speed and security that no other fastening device or method can match!*

How P-K Self-tapping Screws Simplify Fastening Jobs . . .

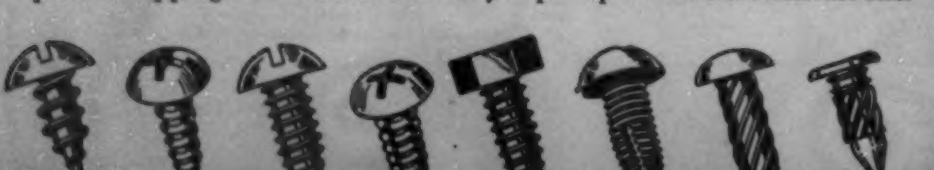
One easy operation makes a fastening with P-K Self-tapping Screws . . . merely drive the Screws into plain untapped holes. Such simplicity eliminates tapping and tap maintenance . . . solves the problem of getting scarce taps . . . stops fumbling with bolts and nuts and placing of lock washers . . . does away with inserts in plastics . . . cuts out riveting and welding in hard-to-get-at places.

Start now . . . *question* every fastening! Be sure you can't employ the simple Self-tapping Screw method before you put up with a more difficult one.

Call in a P-K Assembly Engineer to check over fastening jobs with you. He can show you how to search out ALL opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they will do the job better and faster. If you prefer, mail in assembly details for recommendations.

Change to Self-tapping Screws Over Night . . .

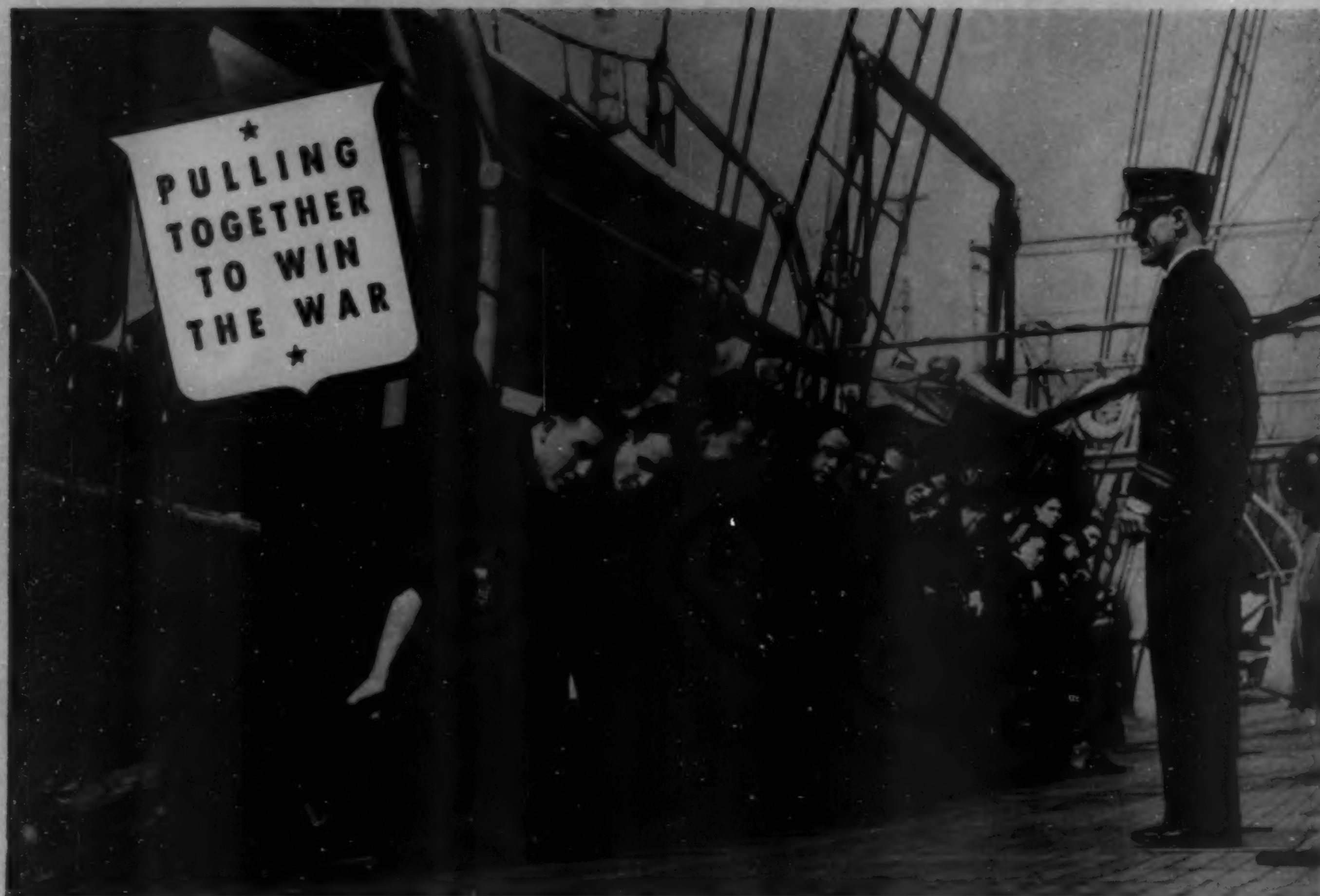
No matter what material you're working with . . . light or heavy steel, cast iron, aluminum, brass, plastics . . . you can adopt P-K Self-tapping Screws to advantage. And you can make the change-over without interrupting production. No special tools or skilled help are required. Parker-Kalon Corp., 190-200 Varick Street, New York, N. Y.



SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

Give the Green Light to War Assemblies



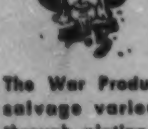
HOW HARD CHROME PLATE IMPROVES PLASTIC MOLDS

Here at Hartford Chrome, our wartime business is increasingly with plastics manufacturers. We've shown others how to use chrome to advantage; we'd like to show you.

Take just the one important example of plating plastic molds. Hard chrome plate improves them in at least six ways: 1) Corrosion resistance. 2) Free extraction of molded part. 3) Higher finish of molded part. 4) Longer wearing life of mold. 5) Better flow of compound. 6) Uniformity of molded pieces over a period of time.

For the same reasons, hard chrome plate is unequalled for salvaging and reconditioning worn plastic molds; frequently making them better than when new! With salvaging a national problem today, this fact is naturally of paramount importance. If you're a present, or potential user of hard chrome plate, get in touch with Hartford Chrome. You'll find us up-to-date and perhaps a little ahead of the field, in our work with plastics. Our experience with plastic molds, and many other parts used in your industry, can save you time and money, and speed your wartime production.

Serving New England & New York



OKAYED BY UNCLE SAM TOO!

The War Production Board has recommended that you salvage various tools, dies and imperfect articles through plating. Write for our circular giving full details.

INQUIRIES FOR ESTIMATES WILL BE GIVEN IMMEDIATE CONSIDERATION

HARTFORD CHROME CORPORATION

525 PARK STREET • HARTFORD • CONN

Licensed by United Chromium Inc.


Designed especially for the Plastic Industry!
THE OLSEN
PLASTIVERSAL
50,000 POUND CAPACITY
Here is the last word in Universal Testing Machines for the Plastics Industry. The Plastiversal was designed by Olsen to meet the specific needs of Plastics manufacturers and fabricators. Judging by the immediate response accorded it, this is equipment which fills a long-felt demand. Every detail has been engineered down to the last bolt on the recorder drum. Whether or not you have an immediate need for the Plastiversal, get the facts about it in Bulletin 23. A copy is yours for the asking.
TINIUS OLSEN TESTING MACHINE CO.
500 NORTH TWELFTH STREET, PHILADELPHIA, PA.
Western Representative: PACIFIC SCIENTIFIC COMPANY
Los Angeles, San Francisco, Seattle
OLSEN TESTING MACHINES FOR Plastics
BULLETIN
23
Tinius Olsen Plastics Testing Equipment for compression, tension, flexure, stiffness, distortion, flow, impact. Write today for your file copy.

NOT A SUBSTITUTE — AN IMPROVEMENT

YOU can now have the best high-frequency insulating material ever made — polystyrene — in the form of *tough and flexible* sheets . . . POLYFLEX.

CONDENSER and STORAGE BATTERY and CABLE manufacturers, among others, will immediately recognize the important advantages of POLYFLEX:

- Zero water absorption.
- Dielectric strength of excellent mica.
- Low dielectric loss of fused quartz.
- Flexibility of phenolic-coated papers, achieved by three-dimensional molecular orientation.

Samples are available *now.* Tell us what widths, thicknesses and tolerances especially interest you. PLAX's exclusive POLYFLEX production is readily adaptable to your needs. Please write or wire *today.*

A FEW TYPICAL EXAMPLES OF PLAX POLYSTYRENE MACHINED PARTS

PLAX machines polystyrene parts in a multitude of shapes and sizes for many purposes, thus removing all molding limitations. PLAX is shipping special and standard electronic parts in any quantity, to any degree of accuracy — on time. Please write for details.

ELECTRICAL PROPERTIES OF PLAX POLYSTYRENE

Arc resistance (ASTMD-495-38T) sec 240-250.
Dielectric strength, volts/mil:

.005" thick = 3500
.010" thick = 2500
.015" thick = 2200
.125" thick = 500-700

Frequency Cycles	Dielectric Constant	Power Factor
60	2.5-2.6	.0001-.0002
1,000	2.5-2.6	.0001-.0002
1,000,000	2.5-2.7	.0001-.0004

PLAX CORPORATION 133 WALNUT ST. HARTFORD, CONN.


WOOD
★ ★ ★ A NEW BOARD PRESS
Among the many presses recently produced by R. D. Wood is this 800 ton Wall Board Press, platen size of 9'1" x 13'10", which is equipped with a bronze filter plate. This unit is one of numerous examples of how Wood engineers cooperate with every branch of industry in answering requirements for standard and special hydraulic presses and equipment.
R. D. WOOD CO.
PHILADELPHIA · PENNSYLVANIA
HYDRAULIC PRESSES FOR EVERY PURPOSE

HOW TO GET THE MOST OUT OF YOUR LATHES

No. 3 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

Keep Your Lathes Level

The leveling of a lathe can either perpetuate or destroy the best craftsmanship of the machine tool builder. A lathe that is not kept perfectly level cannot turn out the precision work for which it was built.

The lathe bed is comparable to a toolmaker's surface plate. Upon it rest the headstock, carriage and tailstock. Therefore, any twisting of the lathe bed will throw the headstock, tailstock and carriage out of alignment. This will cause the lathe to turn or bore a taper instead of taking a straight cut. It will also cause the alignment of the tailstock center point to shift as the tailstock is moved along the lathe bed, necessitating constant readjustment of the tailstock top set-over.

Every lathe should be checked periodically to see that it is level

Check Leveling Frequently

The major cause of distortion in lathe beds is the settling of the floor supporting the lathe. This is most commonly encountered in buildings that do not have solid foundations or that have wooden floors or columns. There are numerous other conditions which can cause this, such as the shifting of loads on the floor, swelling of wood flooring, deterioration of wooden shims, and atmospheric changes. For these reasons, every lathe should be checked periodically to see that it is level.

How to Level a Lathe

The first requisite for accurate leveling is a precision level at least 12" long. One that is sufficiently sensitive to show a distinct movement of the bubble when a .003" shim is placed under one end of it. A carpenter's level, a combination square level, or an ordinary machinist's level cannot be used because they are not sufficiently sensitive.

The leveling of the lathe is tested by placing the level squarely across the lathe bed, immediately in front of the headstock, and also at the extreme right end of the bed. On lathes having long beds, tests should also be made at one or more intermediate positions. Be sure that the ways are wiped perfectly clean of all chips or dirt before using the level.

Metal shims should be used under the lathe at the points indicated by the level as being low. Some lathes are equipped with leveling screws making it unnecessary to use shims.

After all adjustments have been made, bolt the lathe securely to the floor and repeat the tests to make sure that tightening the leg bolts has not affected the leveling of the lathe.

Alignment Test

A simple alignment test can be used to check the leveling of a lathe. Place a bar of steel, one inch or larger in diameter, in the chuck and machine two collars of equal diameter three or four inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. If the collars are not the same diameter, it is an indication that the lathe is not level. Adjust the leveling until, when a cut is taken, both collars are turned the same diameter.

Write for Bulletin H3

Bulletin H3 giving more detailed information on the installation and leveling of lathes will be supplied on request. Also reprints of this and other* advertisements and bulletins in this series. State quantity.

*Ad. No. 1, "Keep Your Lathe Clean"
Bulletin H1, "Keep Your Lathe Clean"

Ad. No. 2, "Oiling the Lathe"
Bulletin H2, "Oiling the Lathe"

SOUTH BEND LATHE WORKS

South Bend, Ind., U. S. A. • Lathe Builders for 36 Years


THE DEVELOPMENT POSSIBILITIES
OF PAPER
FOR WAR INDUSTRY
A presentation of the
Laboratory and Production Facilities
of
BYRON WESTON COMPANY, DALTON, MASSACHUSETTS

Hobbed Cavities by Midland . . .

NO JOB TOO *Large*
NO JOB TOO *Small*

★ At Midland Die and Engraving Company you'll find complete facilities for Plastic Molds, Die Cast Dies or Hobbings, Engraved Dies, Steel Stamps or fine Pantograph Engravings—facilities complete under one roof and unsurpassed in the entire industry . . . For example, hobbing presses ranging from 100 to 3000 tons as well as complete tool and engraving departments are at your instant service always.

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Makers of Plastic Molds • Die Cast Molds • Engraved Dies • Steel Stamps • Hobbings • Pantograph Engraving

Sink Stoppers made by Kampa Mfg. Co. from Celanese-Celluloid Corporation's Lumarith, based on Hercules Acetate

IF YOUR PROBLEM is to get a plastic that stands up under heat, please take a second look at this really significant photograph. The stoppers are acetate. And the fact that they can take piping hot water has implications of great importance to a great many manufacturers.

THE SPECIAL FORMULATION which produced this heat-tough plastic is typical of the ways in which acetate is being varied to develop special characteristics for special requirements. No other plastic material has the versatility of acetate. No other offers this unique combination of stability and toughness, flexibility and light weight, dielectric strength and resistance to destructive agents. It is economically and speedily fabricated—and all scrap can be re-worked.

OUR PART IN THE plastics picture is to supply those who make plastics with Acetate of exceptional quality. Years of experience and continuous research have helped us make it an ideal molding powder base. For literature, address Department M-12.

HERCULES

CELLULOSE ACETATE

★

TOUGH • FLEXIBLE • STABLE
LIGHTWEIGHT • ECONOMICAL • CLEAR

HERCULES POWDER COMPANY • WILMINGTON, DELAWARE
Incorporated

A BETTERMENT . . .

Not a Substitute

What manufacturer who has turned from slow, heavy riveting construction to modern, high-speed, light, dependable welding would want to turn back to riveting.

This development in production practice has crystallized so fast it might even be called a revolution.

Ship, tank, and other structural steel-makers, who yesterday were using riveting, are today staunch supporters of welding.

In almost as short a time Continental-Diamond NON-metallics have replaced many habitually used heavy—corrosive—costly materials. Likewise these new users of C-D NON-metallics will not want to go back to the replaced materials . . . even when they become plentiful. The reason . . . C-D NON-metallics are doing a better job—they have lightened weight, increased life, speeded up production, provided for the welfare and protection of workers.

There will be few who return to riveting and still fewer who will give up the "betterments" achieved when C-D NON-metallics are properly designed into their products.

The C-D booklet will give you basic data on FIVE C-D NON-metallics. When writing for it, ask for Booklet GF-6. Then, when you are ready to discuss your particular problem . . . write, wire or phone for a C-D Laboratory Research Representative.

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

Reveille for PLASTICS

★ *The original of the horn shown in the illustration is molded of plastic and has been approved by the Quartermaster Corps for use in their services to replace brass instruments. It is now being molded in large quantities.*

THE DAWN leads on another day. We talk of yesterday — we dream of tomorrow. But *today* we live.

The new generation of the twentieth century, eager to advance with the sunlight of a wonderful era in its eyes, finds guns thrown across its path. In the order of human history the Age of Work follows the Age of War. *Tomorrow* is the heritage of the children of today.

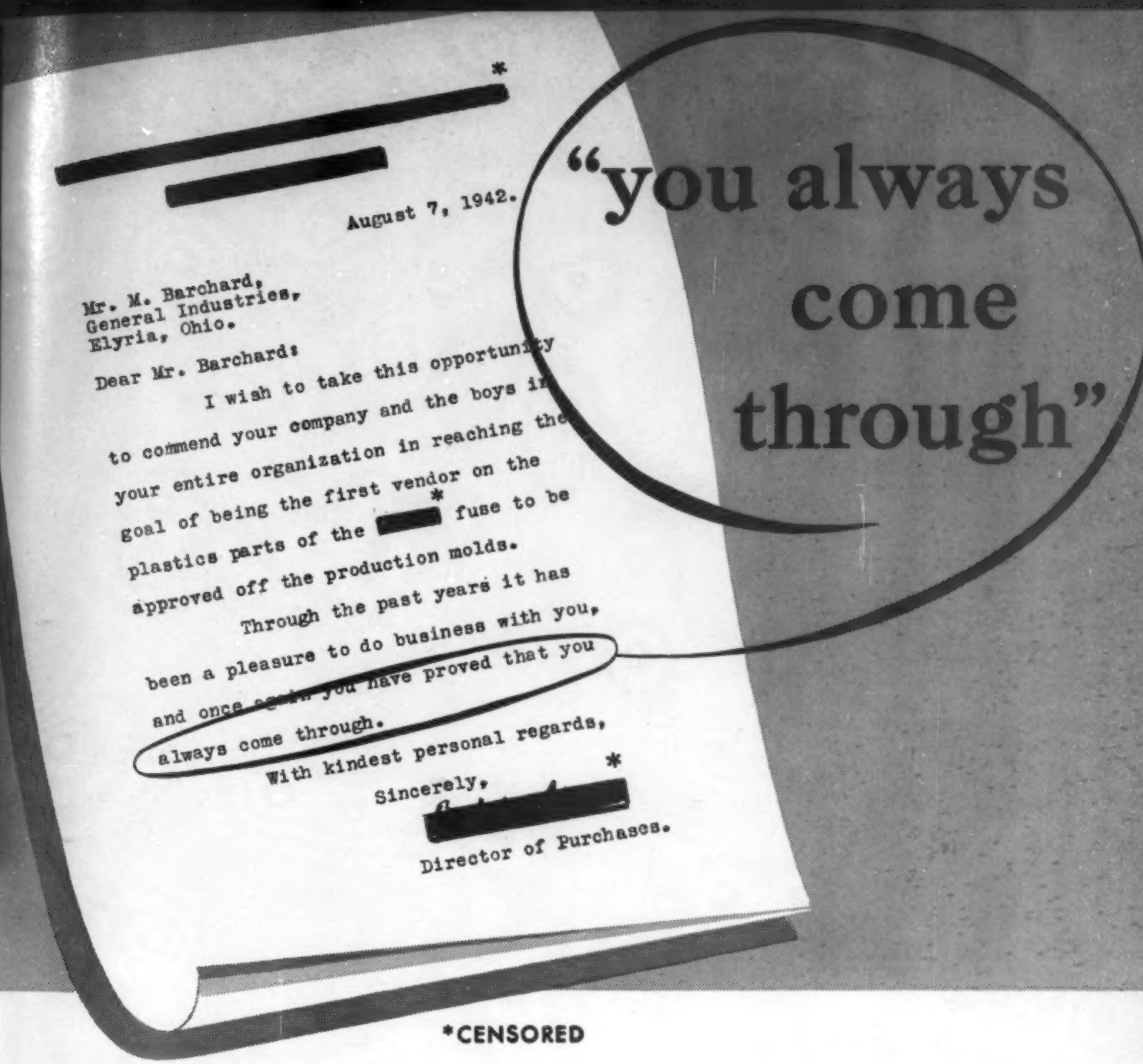
The new plastics age of tomorrow offers unlimited opportunities to the manufacturer of today. Plastics, in the very near future, will replace steel and other essential metals for many products. Industry everywhere is recognizing the importance of introducing plastics in the present emergency, with a vision of complete and final victory.

The Rodgers Hydraulic Impression Press, available again when peace comes, is acknowledged a leader in this field of tremendous plastic potentialities for after the war. If it's a Rodgers it's the best in Hydraulics. Rodgers Hydraulic Inc., St. Louis Park, Minneapolis, Minnesota.

Manufacturers of

UNIVERSAL HYDRAULIC PRESSES • HYDRAULIC KEEL BENDERS • HYDRAULIC TRACK WRENCHES
TRACK PRESS EQUIPMENT • HYDROSTATIC TEST UNITS • PORTABLE STRAIGHTENER FOR KELLY'S AND PIPE

Rodgers HYDRAULIC Inc.


[redacted] *
[redacted]

August 7, 1942.

Mr. M. Barchard,
General Industries,
Elyria, Ohio.

Dear Mr. Barchard:

I wish to take this opportunity to commend your company and the boys in your entire organization in reaching the goal of being the first vendor on the plastics parts of the * [redacted] fuse to be approved off the production molds.

Through the past years it has been a pleasure to do business with you, and once again you have proved that you always come through.

With kindest personal regards,

Sincerely,
* [redacted]
Director of Purchases.

*CENSORED

WE PRIZE MORE than any award the commendation of our customers for work well done and delivered "On Time." The plastics parts referred to in this letter are among the most difficult ever turned out. Production was undertaken by other molders in advance of General Industies, yet General Industries was the first to deliver. It is this record consistently maintained for "coming through" with quality, accuracy and "On Time" that has brought General Industries to the forefront among America's plastics molders.

THE GENERAL INDUSTRIES COMPANY
Molded Plastics Division . . . Elyria, Ohio

GENERAL INDUSTRIES

★ ★ MOLDED PLASTICS ★ ★

A Harness for 1300 Horses

In MELMAC*, aircraft engineers have found a harness for the "runaway" electric current in engines of the highest horsepower. Dielectric strength, high arc resistance, heat resistance, plus the right combination of other properties, make MELMAC the ideal electrical insulating material. And the dangers of "flashovers" and "shorts" have been virtually eliminated.

But MELMAC's use is not limited to aircraft. For ships, trucks, tractors, automobiles, and in electrical equipment throughout industry—where conditions of service may range today from arctic cold to tropic heat—MELMAC's unique properties will meet your demands for dependable insulation.

TYPICAL APPLICATIONS: Ignition assemblies, insulation parts, shields, switch plates and boxes, relays, circuit breakers, controls.

TYPICAL SPECIFICATIONS: MELMAC (Mineral Filled)—*A typical formulation:*

Dielectric strength: 430 Volts/Mil.
Arc resistance (ASTM) average: 165 sec.
Heat resistance: 400° F.

MELMAC, melamine-formaldehyde thermosetting plastics developed by Cyanamid, are continually finding new uses, continually being adapted or modified to meet new and specialized requirements. Write for further information. Data sheets are available. A Priority Rating is currently required for commercial use of MELMAC. However, samples can be supplied without priority for research and testing purposes.

AMERICAN CYANAMID COMPANY
Plastics Division
30 Rockefeller Plaza • New York, N. Y.
*Reg. U. S. Pat. Off.

Melmac

A CYANAMID PLASTIC

Modern Plastics
DECEMBER 1942 VOLUME 20 NUMBER 4

The Army gets new buttons

Although buttons first made their appearance on man's apparel in the 13th Century, it was not until two centuries later that they were employed as a common fastening device. Because the earliest buttons were used solely for purposes of ornamentation, the word came to be, in common with "straw," "pin," "farthing," and a score of others, a synonym for something trivial, worthless and of no functional significance.

And in the far-flung activities of the U. S. Army, such inconsequential items as buttons might seem to be of small importance. So great a military genius as Napoleon, however, once remarked that "battles are lost by the little things." Consider that literally millions of buttons fasten Army personnel into their regulation clothing, and think what disasters could attend the popping of even a few dozens of them at crucial moments....

On clothing worn by men in the United States Army, there are two principal types of buttons: the sewing-hole button and the shank or staple button. The sewing-hole button is ordinarily used strictly for the utilitarian purpose of fastening. The shank button usually has a dual function—it fastens and it provides identification through the insigne on its face. Most familiar insignia, of course, are the eagle and shield with the motto *E Pluribus Unum* used on Army blouse and overcoat buttons.

A variety of materials go into the buttons used by the U. S. Army, principally bone, vegetable ivory, metal, fresh-water pearl and plastics. Prior to the outbreak of the present war, the majority used were of vegetable ivory and fresh-water pearl, the former on shirts and trousers and the latter on underwear. The brass buttons on blouses and overcoats are shank buttons and will be discussed later.

The vegetable ivory button is formed from the fruit of the ivory-nut palm, a tree growing in South America, principally Ecuador. About 700 to 800 tons of ivory nuts used to be imported monthly, using up large quantities of shipping space. This space was allotted by the War Shipping Administration on request of the Army, which needed buttons and therefore marked vegetable ivory as a critical material.

On July 16, 1942, the Philadelphia Quartermaster Depot requested that a substitute be found for vegetable ivory buttons, and subsequently recommended that the WSA withdraw shipping space priority for importation of vegetable ivory, stating that a satisfactory plastic replacement had been developed. Immediately following this action, the Quartermaster Corps rewrote specifications for all types of Army buttons, tightening them up to insure delivery of high-quality material so that the button might last as long as the garment was serviceable. For field jacket buttons, the Corps specified urea, melamine or phenol; for raincoats, casein, urea, melamine or phenol; for shirts and other washable items previously fastened with buttons of fresh-water pearl and vegetable ivory, melamine; for trousers and breeches, phenol; for mackinaw coats, urea or phenol; for overcoats, urea or melamine.

The Army had three main objectives, the first of which was to get a button which would withstand all conditions of service—the cold of northern climates, the warmth of deserts and dampness of tropical areas, as ~~well as rain~~, snow, sleet, abrasion, alternate wetting and drying, and any other hard usage it might get in any part of the world. It would have to pass tests for washing, ironing, decontamination, sewing and fading. As an indication of how tough and difficult are the tests to which these buttons are put, the following description from the Quartermaster Corps is interesting:

First the inspectors select 35 butt~~ons at random~~ from each batch submitted. These are carefully marked for identification and kept separate from the others. The idea is to select average buttons in each batch and to see how they stand up under every conceivable type of test condition. If the sample buttons pass the tests and their price is right, the batch from which they were selected is purchased by the Quartermaster Corps. If they fail the tests, they are rejected for Army use. An automatic crushing machine subjects the test buttons to tremendous pressures; an electric steaming apparatus tells the investigator at a glance whether the color will stand up properly, and a special sewing machine checks their size and uniformity and determines whether they

Christmas, 1942

Some of the old Christmas carols will be hard to sing this year. Men of goodwill must find something ironic in "God rest ye merry gentlemen," when throughout the United Nations few are resting, and there is little merriment in Europe, in Russia or in the East.

But astronomers tell us that when American troops landed in Africa to stand once more beside their old Allies, the French and the British, a brilliant new star appeared in the southern sky—the brightest nova seen since 1918, the last year of the old World War.

Daily the star is growing brighter, a shining symbol of much that gives us hope and courage for the coming year. The United Nations are on the march; and valiant men and women everywhere will join in the second line of the carol, "Let nothing you dismay."

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are constructed properly for quick sewing by the battery of needles used to make Army clothes.

The second objective of the QMC in specifying plastics for buttons was to relieve the shortage of shipping space. In making the buttons out of plastics, valuable shipping space used for imports of raw materials for buttons could be released for other purposes.

The third purpose of the shift to plastics was to insure rapid delivery with a minimum amount of critical material usage. With this idea in mind, the Philadelphia Quartermaster Depot invited plastic button manufacturers to submit samples of standard buttons made on existing compression molding dies, together with a listing of their capacities for manufacturing each type of button submitted. The buttons are then checked by the Philadelphia Depot to see if they are suitable for Army garments, despite the fact that they may not be made exactly in accordance with the specifications set up. In other words, where acceptable buttons are found, even though they may not conform to Army specifications—in many cases they will be superior to those specifications—the Quartermaster Corps will send an acceptance to the molder and will invite him to bid or negotiate on them. Through this method, the need for new dies will be eliminated on sewing-hole buttons, and the Army will get as good or better buttons than those called for by the specifications.

Tests conducted by the Quartermaster Corps on the new plastic buttons indicate that they are equal to if not better than those they are replacing and cost much less. For example, melamine buttons cost about a third as much as fresh-water pearl and have proved to be just as satisfactory. Urea costs less than a third as much as vegetable ivory and has proved to be just as serviceable. Phenolic buttons are cheaper than vegetable ivory and fresh-water pearl, yet are apparently stronger and have greater wearing qualities.

In the molding of buttons, the curing cycle is extremely important. Undercuring causes, of course, an internal sponginess which tends to make the button absorb water—most undesirable for an article which will be constantly exposed to the elements.

On the other hand, if the button is overcured, it becomes brittle and discolored. The curing cycle naturally varies, depending on the line size of the button (buttons are measured by a system of lines, and the Standard U. S. Button line measure equals $^1/_{40}$ of an inch). Tolerance allowed molded buttons is a 1-line tolerance plus or minus. Buttons of a mottled color, caused by improper curing, are not accepted by the Quartermaster Corps.

On sewing-hole buttons there must be no sharp edges either around the periphery or under the holes. The buttons must have uniformly spaced holes of adequate sizes so that they can be used on high-speed sewing machines without extensive breakage either of buttons or machine parts.

The plastic buttons are subjected to the following curing tests: Melamine formaldehyde—boiled 10 minutes in 1 percent H_2SO_4 (by weight) and rinsed in water; phenol formaldehyde—boiled 1 hour in water; urea formaldehyde—boiled 30 minutes in water. The Quartermaster Corps checks the appearance of the button immediately following its test,

1—Operator places metal staple inserts for shank buttons on mold pins, eyelet side down. 2—Trays of shanks are then inserted in press. 3—Preformed buttons are slipped into press above tray of shanks, which will be pressed into them when the molding press is closed

and if there is any evidence of chalking the batch of buttons from which the samples were taken is rejected.

In addition to this test, the buttons are put through a sewing test which makes certain that they can be sewn satisfactorily on a high-speed automatic button sewing machine. After being sewn on a piece of heavy cloth, the buttons are then pressed in a steam pressing machine without padding under a pressure of 35 lb. at 300° F. for not less than 1 minute. The buttons are also put through a laundering test, and upon removal from the washing machine must stand up after going through the rubber roller type of clothes wringer under ordinary tension. There can be no noticeable change in the buttons after being subjected to air-free steam under 15 lb. pressure for 20 minutes.

The compression test provides that at least five buttons should be placed face down, one at a time, between flat blocks of steel and subjected to a gradually applied crushing load of varying pressure, depending upon the size of the button. It can thus be seen that, although the Government is willing to use standard types of buttons, they still must prove satisfactory under extremely difficult test conditions.

It is estimated that the development of the plastic shank button will save approximately 60,000 tons of brass. This button, just like the traditional brass button, has the insigne of the eagle, shield and *E Pluribus Unum* on its face. Molded from urea formaldehyde in Army olive drab, it may be used wherever brass shank buttons were formerly placed. All shank buttons for the Women's Army Auxiliary Corps will be made of the same material.

The shank buttons when put through the compression test described for sewing-hole buttons, have the shank removed first. They are subjected, however, to a test of their own, with the shank still in place: a 1-lb. weight is dropped 2 ft. on the face of the button, which must not break.

A problem with which one company has had to contend in molding shank buttons is that putting them into large drums immediately after molding results in a large percentage of rejects, due to discoloration. Upon investigation, the company soon discovered that, due to the fact that the metal shanks retained a fairly high percentage of heat, the buttons continued to cure when they were packed in barrels. Eventually they rigged up a device which would insure a sufficient cooling period between the time the buttons were taken from the mold and the time they were put in barrels to be sent to the tumbling room. Figure 4 shows this "cooling tray." Flash is removed from the edges of the buttons and from the holes of sewing-hole buttons by tumbling. As its output of buttons increased, this same company found that an inspection belt onto which the buttons dropped from a hopper and moved past an inspector speeded up the operation considerably. The company estimated that two inspectors seated at a moving belt inspection machine could inspect approximately as many buttons as six girls picking them over by hand.

The annual number of buttons needed for the U. S. Army is in excess of four billion a year. This amounts to, roughly, five or six million dollars of business for the plastics industry which, in addition to supplying buttons for our own Army, will also be called upon to (*Please turn to page 130*)

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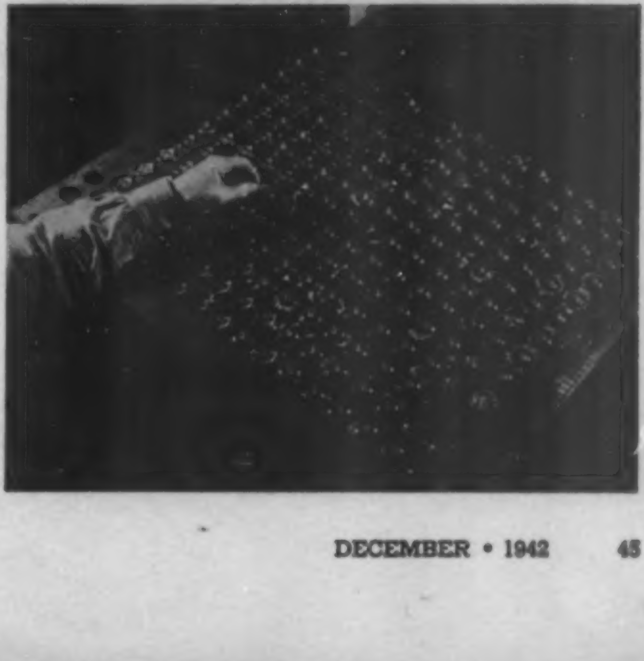

4—As the press opens, buttons are blown into a drying tray. When sufficiently cooled, they will be sent to the tumbling room. 5—All buttons must be carefully inspected for imperfections. 6—A 208-cavity mold is used for shank insignia buttons for the armed forces

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1—Christmas tree ball as it comes from the mold and (right) with flash removed and hole punched for attaching cord or wire. Dropped balls bounce instead of smashing. 2—One-piece toilet float ball is extruded, blown and sealed with one automatic piece of molding equipment

A blowing process for thermoplastics

In the past few years, several attempts have been made to mold a toilet float ball from thermosetting materials. The float ball was molded in two halves and then various glues were used in an attempt to obtain a watertight seal. This seal was achieved, but its strength and uniformity were not satisfactory. As a matter of fact, the balls had a tendency to develop leaks and fill with water, thus defeating their purpose. A period of time was allowed to elapse before further attempts were made to mold such a unit.

Approximately two years ago, a new method of molding for this type of part was developed. Called a "blowing" process, it was said to be adaptable to practically any thermoplastic. By this method, a toilet float ball was produced in one piece, the only additional operation being the threading or other type of forming necessary for mounting the ball.

Although the intimate details of this method are not available for publication as yet, it may be said that through the combination of extrusion into a forming die, blowing to shape and then sealing, a very satisfactory result is achieved. Preparation of the material is a significant phase of the blowing technique. For best results, the molder has found that the material should have less than $^1/_3$ of 1 percent moisture content. When received it has approximately 5 percent. Therefore it is placed in a barrel type rotating drying oven and, after the excess moisture is removed, sealed in steel drums until it is ready for use. Molding operations are all done with one fully automatic piece of molding equipment. Figure 2 shows the toilet float ball exactly as it comes from the mold.

Even before formally declaring war on Japan, the people of the United States began to boycott nearly all products bearing the label "made in Japan." One group of items which previously had had a large sale in the States was Christmas tree decorations. With the advent of this boycott, several plastics manufacturers saw a new field, namely, Christmas tree balls, and immediately built injection molds for the purpose of molding these parts. Inasmuch as the Christmas tree ball had to be molded in two halves and then glued together, the finished product was rather expensive.

However, by the use of this new "blowing" process, Christmas tree balls are now being molded in one piece with very satisfactory results, and at a very economical price. One fully automatic machine is said to produce over 30,000 Christmas tree balls in a 24-hour day.

These Christmas tree balls are practically completed when they come from the mold, and need but one further, fully automatic operation to make them ready for shipment. This is the finishing off of the top of the ball. An operator puts the balls in cups on a rotary type punch press. As they swing around the circle, the machine removes fins and punches a hole through which will be slipped the string or wire that attaches ball to tree. A well-directed blast of air then blows the balls from the machine into a barrel, whence they are taken for packing and shipping. Unlike glass balls, these gayly colored ornaments are not at the mercy of poppa on his stepladder, the younger children eager to be helpful, and the playful gambols of the family dog.

Figure 1 shows the Christmas tree ball just as it drops from the mold (left) and after it has had its one finishing operation.

Credits—Blowing process developed by Plax Corporation.

Methacrylate disk warns of ice formation

One of the greatest hazards of flying is the ice which forms on wings and plane surfaces, causing a ship to lose altitude and frequently responsible for its crashing. Now a plastic disk set in the leading edge of an airplane wing is helping to overcome this source of danger by acting as the sensing element of the ice indicator developed by the aeronautical laboratories of the Minneapolis-Honeywell Regulator Co.

The indicator, an ingenious device which utilizes principles of the new science of electronics, is said not only to measure the thickness of ice accumulation for the first time in aviation history, but also automatically to turn on plane de-icing equipment at the exact moment when it will be most effective. This new aid to aviation will lighten the burdens of pilots—who have a lot of things besides ice to worry them—increase the efficiency of Allied bombing planes and, when peace comes, make all-weather commercial flying safer.

Dr. Waldo Kliever, the 35-year-old physicist who, with his assistant, Richard Franzel, invented the device, announces that plastics have been used in several vital parts of the indicator. The key to the operation of the indicator is the electrode carrying electrical impulses which are transformed by the ice. These impulses are transmitted to the meter on the instrument panel and are harnessed to turn on the de-icers. The electrode is set within a disk formed from methyl methacrylate, chosen for its good electronic properties, low loss factor, low water absorption and ability to be formed easily. The disk is curved to fit the leading edge of the plane wing and usually is mounted under the de-icers. The company's aeronautics division is now testing for the disk a new plastic made of a phenolic-fiberglass combination which looks like monks cloth.

Behind the sensing element is a small box containing the amplifier. Shock-mounted to eliminate as much vibration as possible, this unit produces and measures impulses from the electrode and transmits them to the power supply unit, another small container housing the mechanism which does the actual work of turning on the de-icers and operating the meter on the instrument panel.

Plastic parts in the apparatus besides the sensing element include the switch mounting which controls the whole mechanism, coil forms, condensers, the relay in the power supply unit, potentiometer and fuse holders. Most of these are made from a thermosetting phenolic resin.

The ice indicator is only one device in which the company, a manufacturer of precision equipment, is utilizing plastics. Henry F. Dever, vice-president in charge of engineering, says that plastics have been used for some time in heating and industrial controls, especially in switch or condenser mountings and other electrical equipment, and are now being substituted for strategic metals.

One example of this critical metal replacement is the screens or covers in three series of thermostats in which thermoplastics have taken the place of vital zinc die cast material. Plastics also perform a notable war job under fire in the sighting equipment which the company is manufacturing for tanks. The mirrors are set in a plastic mount, partially exposed to direct fire. All tanks carry spare plastic mounts to replace a part that may be shot away.

The company has its own complete plastics molding department, which is likely to assume a more important rôle with the expansion of automatic controls that is expected to come after the war.

PHOTOS, COURTESY MINNEAPOLIS HONEYWELL REGULATOR CO.

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1—Parts that make up the electronic ice indicator, left to right: box containing the amplifier; plastic pickup plate or sensing element; meter which is mounted on the instrument panel; power supply unit which not only operates the meter but can automatically turn on the de-icers. All together, these parts weigh less than five pounds. Note that amplifier and power unit are mounted on springs to take up vibration. 2—Methyl methacrylate sensing element mounted in wing of plane in which the indicator was tested

Elastic plastics for war production

by J. R. PRICE*

Plasticized vinyl chloride-acetate resins offer many advantages over rubber and other flexible materials, and help to relieve current natural rubber shortages

Current rubber shortages focus increasing attention on the opportunities for replacing this vital material with plastics. Among the well-established plastic materials now releasing large quantities of rubber for those uses to which it is most suited are the plasticized vinyl chloride-acetate copolymer resins. These elastic plastics, because of their unusual flexibility, resiliency and stretchability when fabricated, should not be regarded merely as another substitute for rubber: in numerous respects they are far superior to rubber. They are immune to many of the factors that cause rubber to deteriorate and will outlast it many times under certain conditions. They provide characteristics, such as wide color range and transparency, that hitherto have been impossible to obtain. And, although they are compounded similarly to rubber, they are, in many instances, much more rapidly and economically fabricated into finished products.

In their natural form, vinyl chloride-acetate resins, from which these elastic plastics are produced, are white, fluffy powders. They are supplied in this form to those industries which have processing equipment, such as the rubber industry, for compounding into coating materials and other products. A number of compounded, or semi-fabricated, forms are also produced. Sheeting and film are supplied in a wide range of transparent and opaque colors, in rolls of various widths and thicknesses.

These can be cut and punched with standard tools, and bonded by sewing, cementing or heat-sealing. Other compounds are produced for calendering onto cloth; for extruding, like rubber, into continuous rods, tubes, edgings and coverings for electrical wires and cables; and for molding either by the compression- or injection-molding processes.

The properties of elastic vinyl plastics vary widely depending on the grade of vinyl chloride-acetate resin, the type and amount of plasticizer, and the type and amount of fillers and other ingredients. Table I illustrates the properties of three typical sheeting formulations based on a high molecular weight vinyl chloride-acetate resin and containing, respectively, 30, 35 and 40 percent by weight plasticizer. Other compositions are used to meet special electrical, mechanical or chemical requirements.

Advantages of vinyl elastic plastics

Non-oxidizing and non-aging—Elastic vinyl chloride-acetate plastics are noted for their unusual resistance to oxygen and ozone. Oxygen bomb tests, such as conducted on resin-coated cloth for Army raincoats, prove them to be immune to oxidation at ordinary temperatures. Neither long periods of aging nor prolonged exposure to sunlight will cause any appreciable change in physical or electrical characteristics. They will not deteriorate during long periods of service, even in hot, humid, tropical climates.

Tough and abrasion-resistant—The toughness and abrasion resistance of elastic vinyl chloride-acetate plastics are unsurpassed by those of any other flexible material. Tensile strength is greater than that of rubber compounds of equivalent characteristics. In recent abrasion-resistance tests, special formulations demonstrated more than twice the life of standard high-grade rubber compounds. This extraordinary resistance to abrasion is still further demonstrated in a test on 19-oz. duck, used for floats and other inflatable equipment,

*Plastics Div., Carbide and Carbon Chemicals Corp.

1, 2—Handle for the Walter Kidde & Co. fire extinguisher used on Army and Navy planes is compression molded of vinyl chloride-acetate plastic. Like a rubber handle, it is flexible; unlike rubber, it needs no curing or vulcanizing, comes from the mold ready to use

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PHOTOS, COURTESY U. S. RUBBER COMPANY

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3 PHOTO, COURTESY BURNDY ENGINEERING CORP.

4 PHOTO, COURTESY U. S. RUBBER COMPANY

3—The size of this tiny wire terminal sleeve belies its importance. Injection molded of transparent vinyl chloride-acetate, these devices protect and insulate connections in wiring systems of bombing planes. High mechanical and dielectric strength, unusual chemical resistance characterize the plastic material, whose transparency permits easy inspection of terminals. 4—Non-skid, non-scuff floor mats for bombers are of elastic vinyl plastic calendered onto cloth base. Surfaces are embossed. 5—Extruded vinyl tubing protects wiring, conducts water, chemicals and the like. 6—Waterproof Army raincoat is calender-coated with vinyl plastic. This soldier's coat won't get brittle in cold weather or tacky when it's hot. Nor will it develop queer odors. It weighs less than rubber-treated cloth coats

PHOTO, COURTESY IRVINGTON VARNISH & INSULATOR CO. 5

PHOTO, COURTESY U. S. RUBBER COMPANY 6

PHOTOS, COURTESY BURNDY ENGINEERING CORP.

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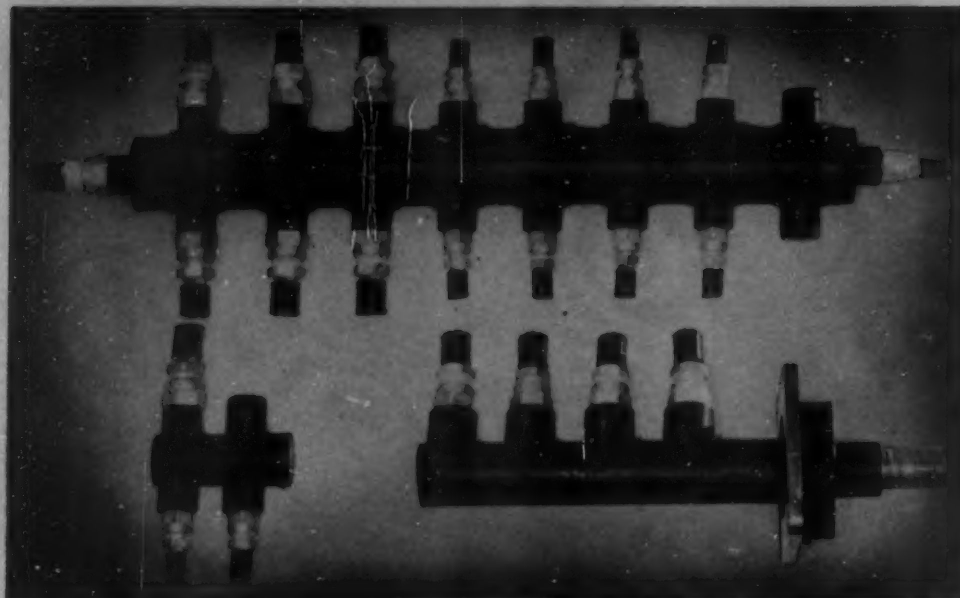

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PHOTOS, COURTESY CARBIDE & CARBON CHEMICALS CORP.

7—For underground wiring systems, a pre-insulated multiple connector, appropriately called a Mole, consists of a metallic conducting core completely covered by a compression molded jacket of vinyl plastic. Covering and sealing the exposed metal parts of the cable terminal clamp, the elastic jacket resists oil, water and gases which the Mole will encounter in service. 8—Vinyl chloride-acetate insulating compound is applied to wire by a special extruding process. As wire passes through the extruding machine, the plastic forms evenly over its surface in given thicknesses

which was calender-coated with a plasticized vinyl resin. In this test, where the inflated equipment was tested for resistance to abrasion and wear, the plastic coating provided 3 times the protection of rubber coatings of the same thickness.

Nonflammable—Unlike rubber and many other flexible materials, certain types of elastic vinyl chloride-acetate plastics will not support combustion or propagate flame. This is an important factor when considering insulation coatings for electrical wires and cables. Many disastrous conflagrations are caused by fire spreading along rubber-covered wires. Since this cannot happen where wires and cables are protected with vinyl plastic insulation, special fire-resistant wrappings or treatment are avoided.

Resistant to water and chemicals—Elastic vinyl plastics are far superior to rubber in resistance to water, oils and grease. Even after 24 hours' immersion in water at 25° C., water absorption is less than 0.20 percent. When plasticizers are properly chosen, the resulting material is resistant not only to moisture and lubricants but also to many acid and akaline chemicals, and neither mold nor mildew will affect it.

Flexible and stretchable—In fatigue resistance, these flexible vinyl plastics compare favorably with rubber. One type of sheeting, for example, will withstand 3,000,000 cycles in a mechanical flexing tester without cracking or creasing, and can be stretched to more than three times its original length at room temperature. Yet even when stretched to such extremes, it returns slowly to size without the "snap-back" common to rubber. This delayed recovery after deformation makes these elastic plastics more suitable than rubber for certain types of vibration damping. Although elastic vinyl plastics tend to stiffen at low temperatures, certain types retain their flexibility even at −50° F.

Excellent electrical insulation—The electrical insulation properties of vinyl plastics, dry or wet, are exceptionally good. Depending upon the type of formulation employed, dielectric strength at 25° C. ranges from 900 to 1100 volts per mil on a 0.025-in. thickness. The dielectric constant, at 1,000,000 cycles per second, is 8.3 to 10.5 at 70° C.

Colorful and transparent—Vinyl chloride-acetate plastics can be pigmented to meet any color requirement, many brilliant or delicate colors remaining stable after long exposure to light. A unique characteristic, impossible with rubber, is that they may be formulated into transparent as well as opaque forms.

Applications

Many important wartime products which previously employed rubber are being served more efficiently and given longer life with vinyl elastic plastics.

Cloth coatings—One of the most important uses is found in the calender-coating of cloth for Army and Navy needs. Army raincoats, as well as inflatable equipment and paulins of many types, are now waterproofed with vinyl plastics. Such coatings do not become brittle, but retain their flexibility at temperatures as low as $-50°$ F. They do not become sticky in hot climates. They do not develop a disagreeable odor after continued use or storage. Cloth coated with a vinyl plastic is generally much lighter in weight than that treated with rubber. Whereas rubber-coated raincoats require 6 to 10 oz. of coating per sq. yd. of cloth, as little as $2^1/_2$ to 3 oz. of vinyl compound are needed. This results in appreciable manufacturing economies.

Heavy elastic vinyl plastic coatings on cloth are employed for upholstering seats on tanks and aircraft. In such hard service they have proved much superior to rubber-base artificial leather in moisture resistance, toughness and flexing life. Wear-resistant floor mats in bomber planes also are

***9**—Rubber-base artificial leather is replaced as upholstery for Army planes, tanks and trucks by tough, flexible, water-repellant vinyl chloride-acetate plastic, embossed and calendered onto a sturdy backing. Dirt and grease can be removed with soap and water.* ***10**—Everyone who has sojourned in a hospital remembers the rubber sheet. Now it is made by calendering both sides with vinyl chloride-acetate.* ***11**—Most important use of the vinyl material is for cable insulation. As primary insulation, it covers wires themselves; as outer jacketing, it protects against water, chemicals, abrasive wear.* ***12**—Vinyl coating was selected for Navy binoculars after a prolonged series of tests. It replaces rubber*

PHOTO, COURTESY TEXTILE LEATHER CORP.

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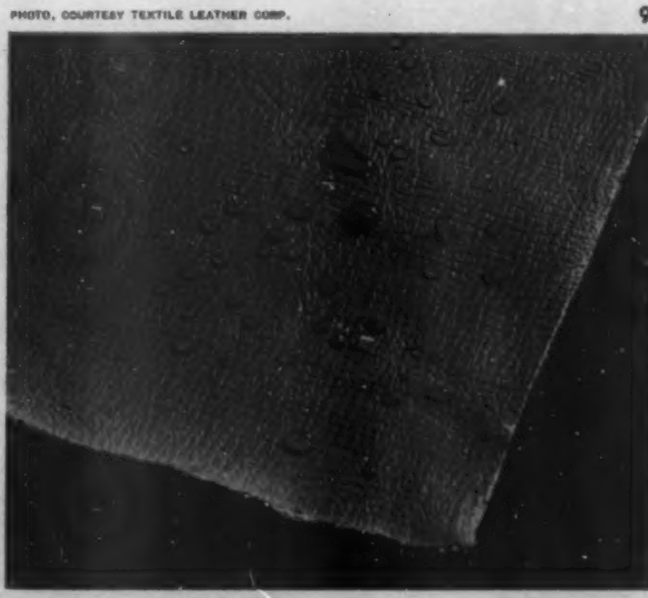

PHOTOS, COURTESY CARBIDE & CARBON CHEMICALS CORP.

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PHOTO, COURTESY L. E. CHASE & CO.

Table I.—Properties of Typical Vinylite Elastic Plastics

	Type 30	Type 35	Type 40	Test Method (A.S.T.M. Test No.)
Tensile strength, lb. per sq. in.	2500	2000	1300	D-412-41
Ultimate elongation, percent	300	330	350	D-412-41
Olsen stiffness index, $\times 10^{-4}$ in. lb. (.040 in. spec.)	145	96	56	See (1)
Low temperature flexibility, T_F, ° C.	−17	−30	−39	See (2)
Tear resistance, lb. per in.	30	25	20	D-532-39 T
Hardness, durometer "A"	86	75	67	See (3)
Fatigue resistance, cycles to failure	500,000	>1,000,000	>1,000,000	See (4)
Abrasion loss, vol. in proportion to "B" rubber as 100	80	70	62	See (5)
Flammability, burning rate, sq. in./sec., .040 in. thick		Nonflammable		D-568-41 T
.020 in. thick	0.2	0.3	0.4	
Specific gravity	1.23	1.20	1.18	D-71-27
Specific heat between 18 and 38° C. (Cal.) (Gm.)$^{-1}$ (° C.)$^{-1}$	0.33	0.35	0.36	See (6)
Resistance to water, oils and chemical reagents:				

These sheetings are very resistant to water, soapy water, dilute acids and dilute alkalies, but stiffen when immersed in alcohol, gasoline and oil. Other compositions have improved resistance to alcohol, gasoline and oil.

Test Methods

Wherever possible, standard A.S.T.M. methods have been used in determining the properties of elastic vinyl plastics. Where no adequate standard tests exist, special methods have been developed which are described briefly below. Unless otherwise specified, all tests were conducted at 25° C. and 50 percent relative humidity.

(1) The flexibility was determined at 25° C. using a Tinius Olsen stiffness tester (Tour-Marshall design). The reported result is the bending moment required to bend a $^1/_2$-in. wide × 0.040-in. thick sample to a 70° angular deflection at 25° C.

(2) The low temperature flexiblity index, T_F, was determined using the manufacturer's "Flex" test apparatus. The reported result, T_F, is defined as the temperature at which a specimen 1.5 in. × 0.25 in. × 0.040 in. is twisted through 200° of arc in 5 sec. under an applied torque of 6.6×10^3 dyne cm. The flexibility at T_F is equivalent to that of a 20 percent plasticized composition at 25° C.

(3) The hardness was determined using a Shore type "A" durometer. Specimens were $^1/_4$ in. thick, the pressure applied to the durometer was 3 lb., and the hardness was read from the scale 5 sec. after the application of the durometer to the stock. The reported result is the average of three determinations.

(4) The fatigue resistance was determined on the manufacturer's apparatus which incorporates the essential features of the A.S.T.M. DeMattia flexing machine used on rubber (D-430-35 T). The "fold-flex at .045-in. radius" test setup was used. The reported result is the number of fold-flex cycles to failure.

(5) The abrasion loss was determined using the manufacturer's apparatus (a modified Kelley-Springfield test) in which four test shoes, equally spaced on the circumference of the test wheel, brush the specimens against an abrasive wheel under controlled pressure as the two wheels revolve slowly in opposing rotation. The abrasive surface is a strip of No. 60 carborundum paper mounted on the circumference of a split-type sanding wheel. The paper was replaced every 20 min. during the test period of one hour. The abrasion resistance is reported as the volume loss of the specimen in comparison with that of the A.S.T.M. Rubber Comparison Standard B (D-394-40).

(6) The specific heat (18–38° C.) was measured using a recognized calorimetric method accurate to within ±5 percent.

made from thick coatings of elastic vinyl plastic, and have deeply embossed skidproof surfaces.

Extruded forms—Many types of vital electric wires and cables are now protected with extruded coatings of vinyl plastics instead of rubber. Being nonflammable and highly resistant to abrasion, much thinner coatings provide equal protection. Transparent tubing, flexible at flying temperatures of −50° F., is employed as conduits for aircraft wiring, thus simplifying the inspection of light and power lines. Elastic vinyl plastic tubing also serves as water- and chemical-resistant hose for inflating floats, and for draining storage batteries. Sliced in half, it is used as weather-resistant and wear-resistant windshield wiper blades for planes.

Molded products—Unusual advantage of elastic vinyl chloride-acetate plastics is their adaptability to both compression molding and injection molding—a characteristic lacking in other flexible materials. In both processes, parts come from the mold ready to use. Curing and vulcanizing, necessary with rubber, are avoided. Compression-molded products for wartime service include chemical-resistant face forms for gas masks and complete tops for storage batteries. With the injection-molding process, transparent terminal insulators for aircraft wiring, grommets, bumpers and many other products are produced at high speeds, and come from the mold completely finished in a single operation.

Savings for rubber manufacturing

Rubber fabricators can realize important savings with elastic vinyl plastics. Curing or vulcanizing, which occupies a large part of the facilities of most rubber plants, is eliminated. The plastic compounds come from the press, extruder or calender mill as completed products. Yet the handling of these materials is essentially the same as the handling of rubber. In many processes, standard rubber processing equipment may be used with only minor alterations, and no extensive re-education of personnel is required.

Availabilities—The foregoing discussion does not imply that vinyl elastic plastics are the immediate and complete answer to the rubber shortage. Army and Navy demands have been increased so rapidly that today the vinyl plastics are among the more critical war materials, and are available only upon direct allocation by the War Production Board. The rapid strides made in fitting these and many other plastics to the exacting requirements of the war will, however, pay dividends in improved peacetime products when victory has been won and production for civilian use is resumed.

Lights that save lives

Stout safety pin and spring clip attach to this seaman's life jacket his plastic-housed flashlight, which will continue to burn should both he and it go overboard. Searchers can locate him by means of the light

The doughty seamen of the Merchant Marine have important parts to play in the tragedy of total war. Theirs it is to distribute food, ammunition and other essential cargos to the farthest outposts of the United Nations. Pursued by wolfpacks of submarines, harried by hostile planes, shelled by surface raiders, every man in the merchant service goes to sea with the knowledge that he may at any moment find himself bobbing about in the ocean.

From this unpleasant predicament he hopes for a speedy rescue; and if he can signal his position to searching parties on sea or in the air, he is more likely to get quick action. With this in mind, our Merchant Marine now requires that each man wear attached to his ubiquitous life preserver a sturdy flashlight.

Both body and cap of the flashlight are injection molded in one piece of polystyrene. The phenomenal water resistance of the material, its great impact strength and high index of refraction, make it adaptable to the humane work of saving men's lives at sea

Early in 1942, when a specification for a life preserver light was initially drawn up by the U.S. Coast Guard, Colvin-Slocum Boats, Inc., manufacturers of boats, life saving equipment and other marine specialties, instructed its engineering department to design such a light to be submitted to the Coast Guard for approval.

The highly specialized use to which this flashlight would be put gave the engineers plenty to think about along lines not usually followed in designing such a unit. It had to be compact, light in weight and at the same time durable, watertight and non-corrosive. To secure these qualities and to avoid using critical metals, the company turned to plastics.

The body of the life preserver light was designed in two parts. Polystyrene was selected for the case, which houses a standard, readily replaceable battery capable of supplying power for a minimum twelve hours of effective illumination. The same material forms the cap or lens of the light, which contains a standard bulb so securely set in a coated reflector socket that it can't be jarred loose. Contact is made by a fractional turn of the lens; and specially designed hand grips on both case and lens provide solid purchase for the user's hands even when both they and the light are wet and oily.

The light is attached to life jacket or suit by a simple spring clip that will not accidentally loosen. If, however, the cloth of the jacket should tear, a three-foot woven lanyard and oversize anchoring pin stand between (*Please turn to page 146*)

ALL PHOTOS, COURTESY MOULDED PRODUCTS (AUSTRALASIA) LTD.

A view of the modern plant of Moulded Products (Australasia) Ltd. in Melbourne, Victoria

Wartime molding in Australia

by J. FRED BROOKS*

Prior to the 7th December 1941, when the South Pacific burst into the headlines as a theater of war likely to be of primary importance to the United States of America, the average American had a very limited knowledge of the geographics of Australia and much less of the industrial development of that country

It was well known that Australia was an island "down under" or, as was more frequently quoted, in the "Antipodes"; but what was not generally appreciated was that Australia is the largest island in the world with a coastline of some 12,210 miles and an area of 2,974,581 squares miles or only 52,208 square miles less than the area of the United States.

With such a vast country, the question of population has always been a problem. Although the Government has sponsored immigration by assisted passages to approved immigrants, the strict control exercised by the "White Australia" policy has prohibited Asiatics from entering the country and, with the present population of slightly less than seven and a half million people, the problem of defense is tremendous.

Until the period of the first World War, Australia was practically dependent on imports for manufactured goods, although the country had taken an important place in primary production of wool, wheat, meat and dairy products. The needs of war during the years 1914–18 and the great difficulty of maintaining sea-borne traffic inspired a phenomenal development in secondary industries—a development made possible by the great wealth of natural resources.

With the exception of oil, in the search for which large sums have been expended, Australia is endowed with rich deposits of most minerals necessary to modern industry, while the range of climate from ten to forty degrees south latitude enables practically all plant and vegetable fibers to be grown successfully.

Radio, one of the industrial developments to be undertaken seriously after World War I, proved to be the basis of the present well-developed plastics industry. In changing over from hard rubber to phenolics for radio parts, many companies installed hydraulic presses for molding of the necessary components but, with so small a population, it was found that equipment was capable of producing in excess of the requirements of the radio trade and other applications were sought.

Probably the first large-scale use of plastics in Australia was the production of bottle caps. Here again, as in the radio industry, this led to further applications; and plastics molders developed a wide range of production in component

* Moulded Products (Australasia) Ltd., Melbourne.

parts which were assembled in articles produced by other industries. It wasn't long before their customers realized the comparatively simple procedure of molding and installed equipment for production of their own requirements. Furthermore, this simplicity of production encouraged people to set up one or two small presses in their home workshops or in automobile repair workshops where a lathe and sufficient other machinery was available for the manufacture of simple molds.

This mushroom growth of the industry was quickly termed "backyard production" by the legitimate molders, and became very troublesome in the initial stages because the "backyarder" was not subject to the usual expenses of a reputable company and often defeated the laws relating to labor payment and conditions by working as a family concern with wife, sons and daughters all working in the common interest.

Actually, the "backyard" competition proved to be another stepping stone to the present-day development of the industry because plastics molders with plants installed were not able to meet this unfair competition and, not being prepared to allow their plants to stand idle, they looked to those avenues where cost and capacity of plant and molds required would put them beyond the range of the "backyarder." Thus came the production of moldings such as radio cabinets, lighting fixtures, intricate electrical and industrial instrument parts in compression molding, sheets, tubes and safety helmets in laminated moldings, and the great variety of articles that flow from the modern injection and extruding machines.

Again, by reason of the small population, the Australian plastics molder has developed his business in a manner and by means somewhat different from those adopted in America. With few exceptions, such as radio cabinets, refrigerator parts, small electrical accessories and bottle caps, orders received would not be of sufficient volume to give constant production. In building up plants, such as one Australian molding company has done, of nearly one hundred hydraulic presses, plus departments for laminating, injection and extruding, considerable cost and effort have therefore been ex-

More than 80 percent of the output of the Australian plastics industry now goes directly or indirectly into war production. 2—Extruded flexible insulation tubing is used by the Government for aircraft, telephone installations and radio equipment. 3—In the laminating field, crash helmets like this one are provided for the hard-riding Army Motorcycle Corps. 4—Laminated also are firemen's helmets and ARP protection hats, hammers, control wheels, items of insulating equipment and lengths of rigid plastic tubing

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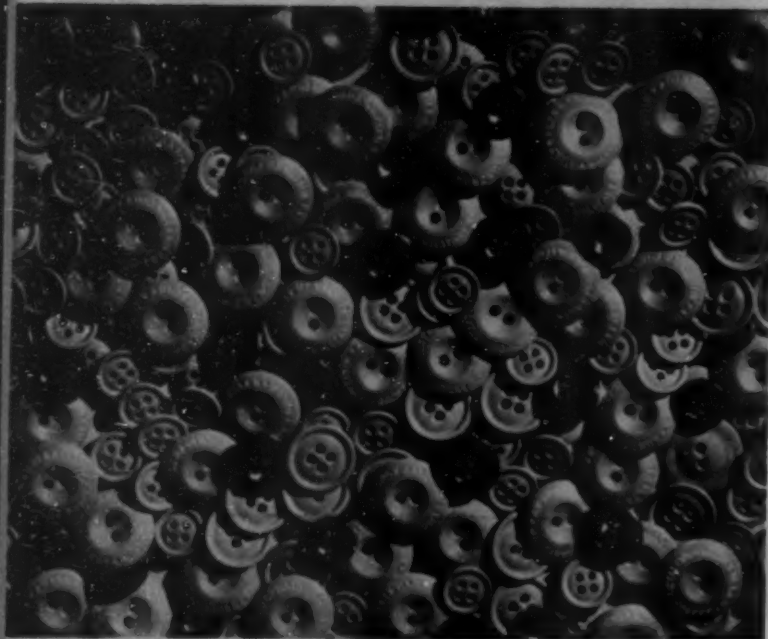

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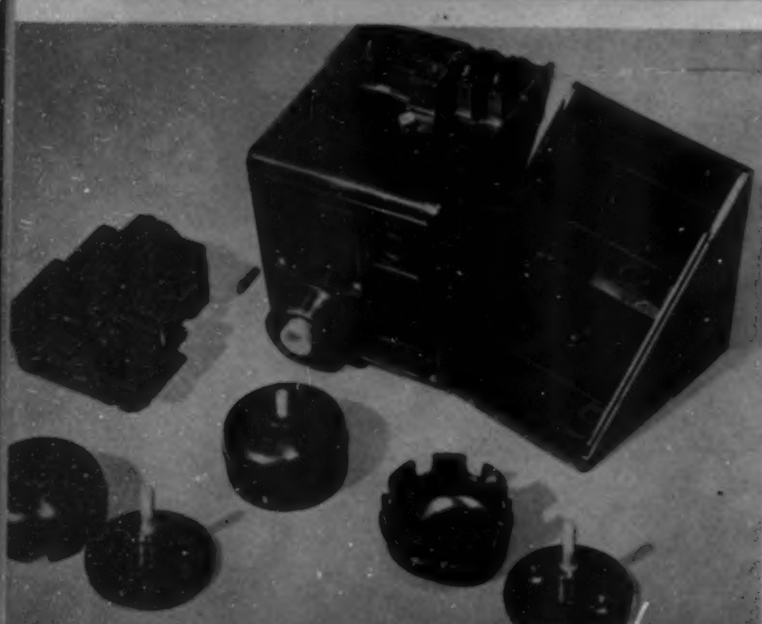

pended in the design and production of articles with universal appeal, commonly known as "standard lines." These include domestic and industrial lighting fittings and fixtures, office equipment, builders' hardware, stationery lines, kitchen equipment, etc., which are marketed through chain and department stores and through wholesale houses for distribution to retailers throughout the country.

While this class of merchandising is also carried on by some American molders, by far the majority of the trade in the U. S. A. is devoted to direct orders, where the customer pays for the mold equipment. In Australia, the position is reversed and at least 75 percent of all molding is in these "standard" or "stock" lines, where the mold equipment is owned by the molding company.

This developing and designing of molds have given the Australian manufacturer a wide experience in mold designing and production, and now stand the nation in good stead when so many plastics applications are required for defense and essential services.

War conditions had very little effect on the plastics industry in the first eighteen months of the war, and it was not until about the middle of 1941 that restrictions began seriously to curtail normal production. From that time on and as the position became more acute with the approach of war in the South Pacific, regulations have been imposed which practically prohibit the manufacture of prewar plastics moldings.

The industry was quick to adapt itself to changing conditions, and from the belief in 1940 that the plastics industry was not suited to production of war requirements, came the realization in 1942 that the industry could and was actually playing an important part in defense needs—so much so that it is now probably more than 80 percent on work for defense and essential services. This percentage is rapidly increasing as new applications are approved and the tools made ready for production.

In fact, some of the larger plants are actually protected establishments where the movement of staff is prohibited by law and the management has no authority to dispense with the services of an employee without permission of the Manpower Authorities.

The first call on the industry was for military and naval uniform buttons (see Fig. 5) and many millions have been and are being produced from equipment mostly installed since the outbreak of war. Then quickly followed molded parts for field telephones, gas masks, aircraft, radio instruments, hand grenades, machine tool knobs and handles, small arms handles and grips, shell fuse caps, electrical instruments, shell transit plugs, signal lamp disks, rifle furniture and, in the lamination field—crash helmets for the Cycle Corps (see Fig. 3) and Tank Corps, A. R. P. protection hats, sheets, blocks and tubes for aircraft and a host of other applications not previously contemplated. Even some prewar

5—First wartime call on the Australian plastics industry was for buttons for military and naval uniforms. Although equipment for molding them has for the most part been installed since the outbreak of hostilities, today they are coming from the presses by the millions. This group has "Australian military forces" molded around their rims. 6—Plastic-covered insulation wire is in demand for military and naval communications. 7—Electrical switchboard equipment is molded for munitions factories and military camps and stores of strong, durable plastic materials

productions, not usually classed as necessities, found their way into the range of wartime requirements.

Certain molded plastics lighting fittings were adopted by the Army for administrative offices. Some lines of tableware were found suitable for canteens and mess rooms. Plastics lamp shades were used in place of metal shades in factories. Switches, switch plates, lamp holders and many other of the ordinary commercial range of electrical accessories (see Fig. 7) were required in the building of munition factories, military camps and stores. In fact, the adoption and extension in the use of plastics were so rapid and satisfying that many Government officials became plastic minded so quickly and so definitely as to expect performance far beyond the bounds of possibility and created a healthy rivalry in efforts to suggest new applications for plastics to replace acute metals.

All this was good for the industry generally and the war effort particularly, because plastics molders had always said: "Tell us what you want and we will tell you if we can do it." Although there are very many applications still unexplored, it has been a revelation to the industry to find that what was formerly accepted as principally a luxury business has proved to be one of national importance in time of need.

Even the new plastics—the styrenes, the acrylics and the vinyls—are all familiar to sections of the Australian plastics industry, and one large company has for some time been supplying the Government with extruded plastic tubing and plastic-covered insulation wire for aircraft, telephone installations and switchboards, and for army radio equipment (see Figs. 2 and 6).

One leading industrialist in Australia had this to say of his country: "In other countries, Australia tends to be thought of mainly as an agricultural country, and its achievements in manufacturing industry are underrated. This misconception should be dispelled. . . . Emphasize the general efficiency of Australian industry and also the important limitations imposed upon mass production and industrial specialization by the size of the population."

At the moment, there is a national job to be done and all interests and efforts of America and Australia must be directed toward the common goal, the overthrow of our enemies. When peace is again restored to the world, the common bond will be even stronger between these two peoples whose language and mode of living and standards and ideas are so identical. There will be a grand opportunity for the American manufacturer to market in Australia a worth while proportion of his plastics raw materials production, the capacity of which has been so greatly increased by war requirements.

8—Corner of the general showroom in the Moulded Plastics plant gives an idea of the wide range of plastic applications produced by the company before war struck. Since the middle of 1941, regulations have practically prohibited manufacture of prewar plastics

8

1—*Evolution of a plastic faucet: upper left, the 1927 version was used in soda fountains, had metal finger grips, cap, plunger. Right, 1940 edition is sleeker, but still wears its metal cap. Below is the wartime model described below (its one-piece body cut away to show assembly), now serving with American troops in the field*

Fountain fixtures in the front lines

by CHRIS J. GROOS*

. . . Or the wartime job of a phenolic faucet which once dispensed fruit syrup for ice cream sodas. Attached to a portable sterilizer bag, it now furnishes water for U. S. troops in the field

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To the U. S. soldier, it will be a faucet or possibly a spigot (or, in the vernacular, "spikit"). His British brother-in-arms will call it a tap. Names will be of small importance, however, to thirsty men who gather around the portable water bag which the Army Quartermaster Corps has provided for troops in the field. When combat troops need water, they get it from any approved available source, purify it, fill the sterilizer bag, and add tablets containing sterilizing reagents. The drinking water is then drawn off through five plastic faucets spaced around the bag into the soldier's cup or canteen.

In the pioneer days of plastic molding, a manufacturer of water coolers and other dispensing equipment developed a phenolic faucet for use in soda fountains. Several operators of establishments selling soft drinks had complained that acids in certain fruit syrups attacked parts of the metal faucets then in use, and the plastic faucet was designed to do away with this nuisance.

After a year of development work, a plastic housing, threaded connections and valve button were molded from a phenol-formaldehyde compound in experimental molds. The result was a utilitarian looking dispenser which functioned perfectly for many years (see Fig. 1, upper left), both on soda fountain equipment and on water coolers of the inverted bottle type.

Some fifteen years later, the unit was redesigned (Fig. 1, top right) for improved appearance and increased structural strength. The finger grips, which in the original faucet were made of metal, were now a part of the molded body, but metal was retained in the cap and in the plunger element.

When America went to war and metal conservation became the order of the day, the Army Quartermaster Corps looked about for a replacement for brass faucets which, in addition to using up scarce supplies of material needed for more lethal purposes, were prone to get out of repair, and proved awkward to handle when troops were on the march.

This particular plastic faucet had served a long apprenticeship and proved its worth. In addition, the production molds were well broken in and immediate (*Please turn to page 144*)

2—*The Army Quartermaster Corps replaces metals with plastics wherever the latter can do the job. A canvas water bag is coated with vinyl butyral instead of rubber and 5 phenolic faucets supplant faucets of brass*

PHOTO, COURTESY MONSANTO CHEMICAL CO.

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* Boonton Molding Co.

Nylon fleece

A second phase in the history of Nylon is now in the making. With the recent launching of the new Nylon fleece fabric currently appearing on the consumer market in the shape of women's coats, hats, purses, belts and various other articles of apparel, Nylon emerges from the sheer luxury stage to the sober importance of a prime utility fabric.

Nylon yarn was the first to appear on the American scene, in the form of women's hosiery and lingerie, men's hosiery and a wide variety of knitted and woven items. Subsequently the yarn was supplemented by Nylon monofilament in toothbrush bristles, toilet and industrial brushes, tennis rackets and strings for musical instruments.

It was, however, via the hosiery manufacturing process that the new Nylon fleece was conceived. From the hosiery knitting process there results some apparently useless waste—short ends, knotted or warped sections of thread, spool leavings and an assortment of odds and ends of filament that can't be utilized in any of the established channels of Nylon manufacture. One enterprising company conceived the plan of using these leftovers by converting them into another form.

The first step was to garnett the waste sections. This is the process of breaking down the thread into small pieces, or into units corresponding to staple fibers analogous to casein, viscose or cotton fibers. (In general, textile fibers are either filaments or staples, which are chopped-up filaments.) After the waste threads have been garnetted, they are then ready for the spinning operation. Since the aggregation of fibers that comprises the new thread is considerably in excess of the number that went into the original filament, the new thread is thus a form of spun Nylon staple, analogous to other staple yarns. Following this operation, the new thread is ready for use, and is knitted on a cotton base in much the same fashion as combination fabrics are manufactured.

The fabric that resulted from this final operation was christened "Nylon fleece." Although it differs in appearance and texture from Nylon yarn, the difference is physical rather than chemical. No changes have been effected in the chemical structure of the Nylon fiber during this process of effective waste utilization, and the same synthetic linear arrangement that makes up the yarn for the hosiery now comprises the sturdy Nylon fleece. According to the company responsible for the development, the material has been subjected to almost every type of test and has emerged consistently with flying colors. Thermal insulation tests, tear tests, dry cleaning tests, tests for water repellence, wear resistance, resistance to dirt retention, thermal conductivity, all seem to point to the conclusion that this new fabric has outstanding wearing qualities.

Credits—Cohama Nylon Fleece developed by Cohn-Hall-Marx from du Pont Nylon.

PHOTO, COURTESY COHN-HALL-MARX

Nothing about this smartly tailored coat suggests that it is knitted of leftovers which once went to waste in the hoisery mills. The beauty and wear-resistance of this new material should make it a welcome addition in the apparel field

Product Development

Repairs and replacements

It may seem like a far cry from Johnny's sturdy shoes to the speedy prosecution of the war effort, but the same plastic material which has for years given strength and resiliency to box toes of shoes is now making possible quick and economical repairs for patterns of metal castings used in foundries.

Such patterns were formerly discarded when they were damaged or impaired in any way. Now, repaired with this plastic material, a test conducted by one company demonstrated that they can give satisfactory service for as many as 200 castings, and still be in condition for continued use.

The material consists of a double-napped cotton flannel similar to a cotton blanket, which has been impregnated with cellulose nitrate and a fire retardant to make it slow burning. Wet down with a solvent, it may be formed into any shape desired, and will retain that shape after drying. It is described as having good adhesion properties, and will stick to wood, metal and other materials.

In repairing a wooden or metal pattern, a piece of this colloid-treated fabric is cut to the desired shape and size, and it may be beveled to a feather edge. It is then wet with a solvent and formed into the shape of the pattern, either with a forming tool or by hand. It dries to a hard, even surface, and may be lightly sanded or shellacked if a smooth surface is desired. The material may also be used for artificial limbs and arch supports.

Credits—Material: Celastic

Dental impressions trays

In recent years plastic dentures and teeth of plastic materials have made news in the dental profession, and have been a boon to thousands of men and women whose comfort and appearance have been enhanced by lifelike plastic dental structures. The latest plastic development to make its contribution to improved dentistry is these new impression trays of cellulose acetate plastic injection molded four to a shot. The trays are used for taking an imprint of teeth and jaw as a guide to the construction of a bridge or plate.

Conceived originally as a replacement for aluminum, these structures have demonstrated their advantage over their metal predecessors on a variety of notable counts. Because it is truly a thermoplastic, cellulose acetate can readily be softened by the application of heat, and hardens again after it cools. This softening–hardening cycle may be repeated indefinitely. In terms of the dental impression tray application, this means that each tray may be adapted to a wide variety of sizes, thus reducing the large number of stock sizes that a dentist formerly had to keep on hand. The tray may be adjusted easily, after a five-second immersion in boiling water, to conform to the dimensions of the patient's mouth.

Agreeable to the taste and touch, cellulose acetate is tough, durable and mechanically strong, so that this new development has been received with enthusiasm by patient and doctor.

Credits—Material: Tenite. Molded by Commonwealth Plastic Co. for Plastic Tray Co.

Ammunition utensils

Funnels and scoops made of molded-macerated phenolic and vulcanized fibre, respectively, represent one example of conversion from metal to plastics that succeeded in conserving metal and in eliminating a serious occupational hazard.

Used in Army Ordnance for handling smokeless powder and filling shells, these items were originally made of tin. In this form, aside from consuming quantities of metal, the funnels constituted a serious potential danger because the soldered joints in the tin funnels gave off contaminating salts which, when mixed with the powder, increased its sensitivity to a dangerous point. In addition, the powder which is poured into shells in liquid form adhered to the metal funnels and built up a waste residue.

The use of lightweight, durable plastics for funnels and scoops eliminated these objections. These materials are non-metallic and can form no dangerous metallic unstable explosive compound in combination with the highly explosive powder with which they are used. The smooth-textured materials provide no adhesive surfaces to which the melted compound can cling. Both materials are non-sparking, eliminating the danger of disastrous conflagrations, and non-corrosive in contact with the high explosives. The low rate of thermal conductivity of both materials retards crystallization of the liquid powder and contributes to unimpeded production.

Credits—Materials: Celeron for the funnels; Diamond fibre for scoops and dustpan

Triple magnification

A departure in magnifying glasses which combines the best features of an efficient industrial eye shade with an effective protective shield has just been developed. This Magni-Focuser Binocular Eye-Shade features a cellulose acetate construction and is equipped with a pair of stereoscopic five-power magnifying lenses which make possible inspection of minutely intricate parts where considerable magnification is essential. It is also adaptable to uses where sharp vision without a great deal of magnification is desirable.

The main body of the eyeshade is injection molded of tough, resilient, lightweight cellulose acetate, which is non-flammable and non-breakable. The head band is claimed to support a weight of 150 lb. with no ill effects. This headband is adjustable to any head size and attaches the device securely to the wearer's forehead, affording him free use of his hands.

The eyeshade is equipped with lenses in which a prism has been ground to relieve eyestrain, and they are scientifically mounted for balance and magnification. Dual mounting of the lenses in the headpiece brings the object under examination into focus at approximately 10 in. from the forehead. Since the depth of an object can be viewed only with both eyes, the use of this device makes possible 3-dimensional vision as opposed to the old-style one-eye magnifying glass. In addition, it tends to relieve eyestrain and reduce fatigue.

Credits—Material: Lumarith. Molded by Claremold Plastics Corp. for Edroy Products Co.

ALL PHOTOS, COURTESY SCHOOL OF DESIGN IN CHICAGO

1 2

1,2—V-springs can be made of any hard wood with a straight grain. The thin strips of veneer, sealed with resin to preserve their moisture content, form a succession of hinged V's

Modern designs from Chicago

by L. MOHOLY-NAGY*

Bed springs and war would seem to be two widely disparate subject headings with little if any relation to each other. Equally divergent in their connotation and implications are traffic signals and peace, but at the School of Design in Chicago, under the catalytic influence of plastics, these antipodal symbols of man's activities are brought into close and timely juxtaposition.

At this school, the concept of industrial design is projected as a complex problem interrelated with, and conditioned by, a body of external factors which help to shape the end product. The School, accepting the principle of mass production as a social and economic fact, and the machine as a tool worthy of the artist's best efforts, trains its students to develop their work in accordance with the current trend and with contemporary scientific, technological and sociological requirements.

What does all this mean in terms of the present, when sudden and unprecedented material shortages are working havoc with established and conventional production practices; when manpower limitations, transportation restrictions and machinery diversions and conversions are leaving their mark on civilian production?

It means simply that at the School of Design in Chicago students are turning to the wealth of material that *is* still available and translating such materials into highly unexpected and unconventional terms of utility, convenience, beauty and timeliness which are the hallmarks of effective design.

Many of these materials are designated by the generic family name, plastics. Plastics represent one of the most complex problems of this industrial age of complexities—relatively new materials, embodying variegated qualities and tantalizing possibilities, and requiring untried production methods. They represent a challenge which can be met only by a well-trained, highly developed imaginative faculty combined with the schooled skill of the artist-technician.

Design projects are formulated so that they draw on the student's inventive capacity and stimulate his resourcefulness. New types of exercises are devised which involve the use of the basic tools and machines of industry, and offer the student opportunity and scope for autonomous research and the application of his findings. Results of each project are analyzed in terms of their possible contribution to an improvement in the next step. For example, in making an analysis of new trends in design it was established that form does not solely "follow function" but also the scientific, technological and sociological trends which include such diverse factors as transportation, distribution, re-creation, etc. Such technological analysis allows a reasonable prognosis for future mass production in any material on the basis of its development history from assembled objects to the point where products are turned out in one piece.

3—Resilient plywood, when bent in curves, produces excellent springs. Compound plywood bends in four directions have been achieved in this experimental spring by using wood with its grain running consistently on the diagonal

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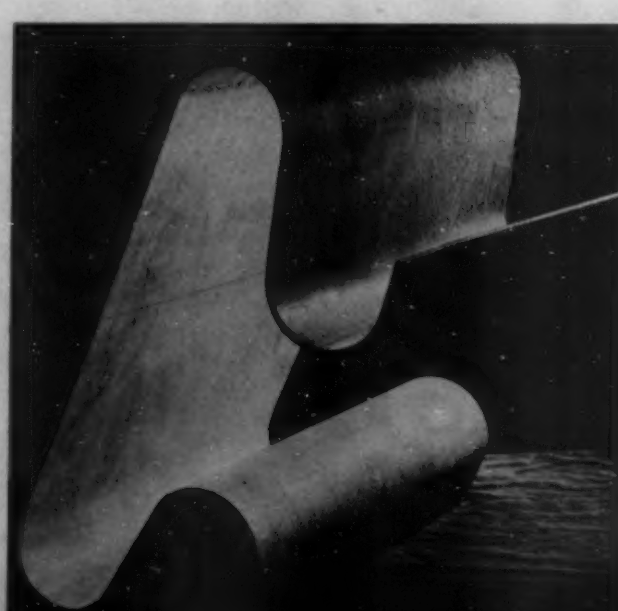

* Director, School of Design in Chicago.

It was found further that the first phase of mass production included assemblage by screwing, riveting and bolting, a stage which reached its peak in the conveyor belt method. The second phase had its inception with the manufacture of the automobile where requirements of accelerated production, streamlining, etc., were conditioning factors, and at this time soldering and welding were introduced. The third phase took in casting, molding and stamping of complete units, and this was the beginning of greatly reduced mass production costs because the number of operations was restricted to minimum requirements, frequently to a single operation. This is the type of production that is currently most common for plastics.

One of the significant results of these investigations, particularly important as a factor in plastic production, is that twists, warpages, curvatures, particularly spherical and eggshell structures render the material more resistant to pressure than if it is used in flat sheet form. Applied to plastic design, this principle has resulted in the development of an entirely new form, one which has proved especially felicitous as an aid in the solution of some of the pressing problems precipitated by the war and its attendant material shortages.

One of the most spectacular departures from established methods has been the recent design and perfection of wooden springs developed for use in chairs, divans, couches, box springs and inner-spring mattresses. This development is particularly noteworthy in the light of the recent WPB Limitations Order L-49 which prohibits the use of metal for the manufacture of furniture springs. The steps leading up to the final production for use stage typify the manner in which such problems are developed from the concept stage to the realistic point of commercial acceptance and distribution.

In order that the student may obtain a working knowledge which will lead to ultimate mastery of the machines of industry, various exercises are devised—in this instance, wood cuts, so-called, which lead the students to an understanding of the most intricate use of the machine and its complete possibilities. In the course of the development of these exercises, it was discovered as long as five years ago that wood could be made as elastic and springy as rubber. In June 1941 anticipating the possible restrictions on the use of metal for furniture springs, experimentation was begun on the development of wooden springs for furniture. About two dozen springs were evolved in which resin-bonded plywood constituted the principal material. However, because plywood is costly, and because it, too, was fast becoming a prime strategic material, a new type of coil spring was fashioned from thin thread-like wood units. To reduce costs still further, veneer V-springs were developed which have been tested and found entirely satisfactory. The V-springs (see Figs. 1–2) so detignated not only because of their obvious contribution os unimpeded war production but also because of their basic V-structure, are built of strips of veneer, hinged at alternate ends to form a structure of successive V's folded over each other diagonally or zigzag fashion. At the apex of each V the strips

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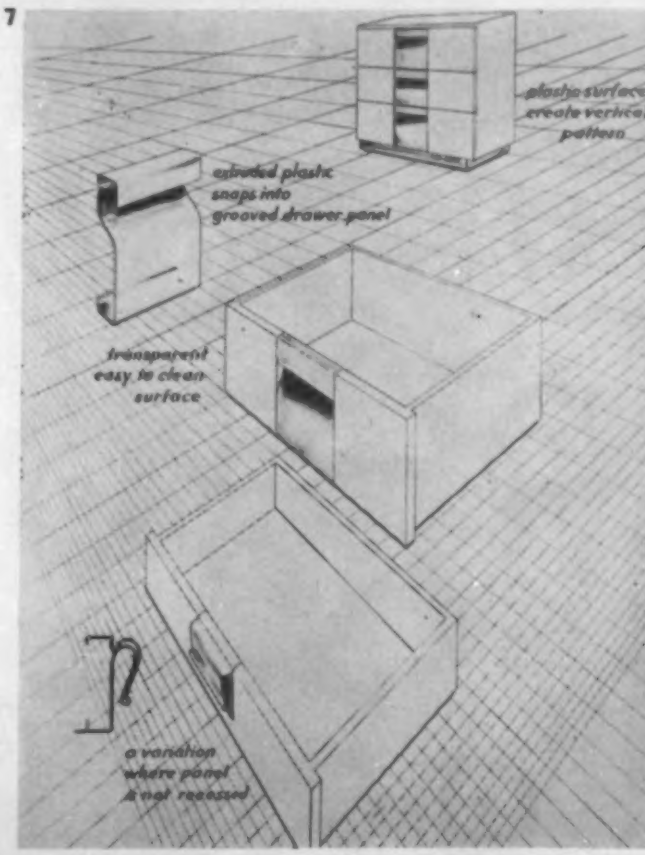

4—Prize-winning design for a traffic light uses neon, fluorescent or methyl methacrylate edge lighting in green vertical (Go) and red horizontal (Stop) strips. 5—Students experimenting with thermoplastics in school workshops designed this graceful transparent drawer pull. 6—Snapped into grooved drawer panels, this type of pull is secure against breakage and keeps fingermarks off the furniture. 7—Diagram of installation of both types of plastic drawer pull, showing how they are fitted to contours of furniture

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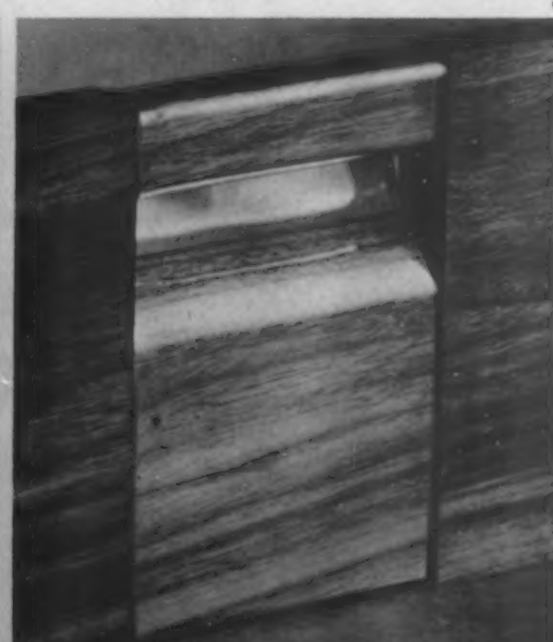

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are held apart by wooden wedges. The degree of elasticity of the spring varies directly with the shape and size of the wedge, and the size and composition of the strips. The pressure ranges from approximately 1 lb. for the cushion type spring up to as much as 50 lb. for heavy furniture springs.

Tests have demonstrated that these wooden springs can simulate any metal spring of any compressive weight, inch by inch to given dimensions; that they are fully as durable as metal springs and equally satisfactory from the standpoint of buoyancy and general performance. They lose some of their flexibility from fatigue in the same manner as do metal springs but, unlike metal springs, they recover their full degree of resilience after they have had a chance to rest.

These V springs can be made from any hard wood with a straight grain. The veneer is sealed with resins to retain its moisture content and to protect it from variations in humidity. The springs have been rendered moisture- and verminproof, and they increase the weight of furniture in which they are used only by 1 or 2 percent.

Out of the same preliminary investigation that led to the development of a commercially and technologically sound wooden spring, sprang another innovation—an easy chair without upholstery, but with the resilience and comfort formerly considered the special providence of the upholstered piece (see Fig. 16). In this plywood construction, the plywood sheet is made long enough so that it can be formed into a very resilient layer suspended at both ends. The suspension itself, with its return bends acts as a brake, securing the seat against breakage. These brakes are also essential to prevent excessive shearing which might result from the difference between the inside and outside circumference of the bends. Uncontrolled, this difference might cause the core of the sheet to break. The side walls of this easy chair are constructed of plywood $^1/_4$ in. thick. The special feature of this construction is the "floating" seat, which can be reclined without any mechanism other than the weight of the body.

A second problem in chair construction presented quite a different situation. An investigation of methods of produc-

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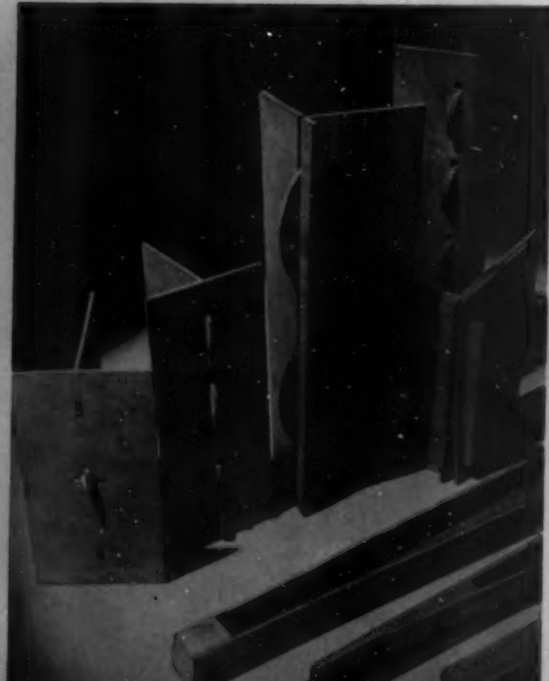

8—Inexpensive plastic air conditioner is designed to hook over the window sill. 9, 10—Plastic walls of postwar motor car are stabilized and strengthened through appropriate curvature without a skeleton construction. 11—Plywood table legs made of curved sheets set obliquely need no additional bracing. 12—Experiments with plywood joints showed that they can be strengthened by enlarging the gluing surface of their plywood edges

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13—Experimental stool of plywood which is an application of the wood spring shown in Fig. 3. 14—Tea table designed for convenient placing of tea service and comfortable grouping of guests. Transparent acrylic legs eliminate the feeling of congestion. 15—Dining room chair of resin-bonded plywood made by bending sheet and joining edges to form a drum. 16—An easy chair which requires no upholstery. Suspension of the resilient layer of plywood with its return bends acts as a brake which prevents cracks. Side walls of the chair are constructed of plywood

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tion led to the conclusion that despite the fact of mass production, chairs are still being manufactured with the mentality of handcraft suitable for limited production. There were, for example, a number of superfluous joints, decorative hand carving, or imitation of hand carving executed by machine, and a quantity of superimposed "decoration" that in no way contributed either to the distinction or to the functionalism of the chairs. There were therefore two objectives established for the redesigning of a chair. First, using technological thinking, to cut down the number of operations and facilitate assembly. Second, the consideration of new materials which would permit putting these new principles into operation. Resin-bonded plywood was fixed upon as the most suitable medium for experimentation because plywood can be bent with an electric bending machine, and the bending results in a structurally more satisfactory product than the flat sheet. It was determined too, that by joining the edges of the bent sheet to form a "tube" or "drum" a very economical structural unit could be achieved, and at the same time an extremely simple method of assembly accomplished. Such "drums" constructed of resin-bonded plywood $^1/_8$ in. thick were produced for the back and seat, and closed in between plywood side walls cut from a single sheet to eliminate leg joints. (Ordinary lumber side walls would have been unsatisfactory because of the danger of breakage at the thin member bridging the front and back legs. The high tensile strength of resin-bonded plywood eliminates this objection.) The side walls can be made from plywood $^5/_{16}$ in. to $^1/_2$ or $^3/_4$ in. thick because a certain degree of thickness is essential for joining the "drums" to the side walls. To counteract a swaying motion, cut-out sheets are inserted as bracing between the two side walls at the front and back, and this expedient simultaneously achieves a strengthening of the legs. Upholstery may be stretched around the "drums" with zipper fastenings to expedite removal for cleaning.

Industrial design is by no means limited to the improvement of furniture or major household (*Please turn to page 150*)

1—*Narrow, continuous strips of ethyl cellulose with interlocking joints, heat-treated and chilled, make flexible tubing*

Tension springs in the nursery

An all-plastic tension spring with both war and postwar possibilities has recently been developed by a Midwest molding company from a thermoplastic material. Although initial production on the spring—believed by its creators to be the first successful plastic spring—is for a strictly peacetime use, it has many war possibilities if tests show it to be as useful as it seems to be.

First production is on an order for 50,000 springs from Childhood Interests, Inc., for use in childrens' exercising equipment. The spring is used as a suspension device for a group of bars and rings over a baby's crib, which enable the budding athlete to exercise while still too young to use standard gymnasium equipment. The spring looks like a plastic version of the familiar screen-door tension spring, with the same hook for fastening at each end. Tested by hand, it has about the same tension and elasticity as an ordinary wire coil of slightly smaller diameter. It can, of course, be manufactured in clear plastic or in a color for decorative purposes.

On its present run, the molder is using cellulose acetate butyrate, extruded in continuous lengths. Thickness of the rod may vary from $^1/_{16}$ in. to $^3/_{16}$ inch. The plastic is tightly coiled on a mandrel on a special winding machine, heated to 220° F. and subsequently chilled. Tension is then put into the spring by an undisclosed method which the company will describe only as a mechanical process. The hooks are formed at each end of the spring by treatment with a hot die.

The spring will stand up in a temperature range of from +120° F. to −40° F. Not designed primarily as a metal substitute, it has the advantage over metal of non-conductivity, non-corrosion and lighter weight. In the use to which it is being put by the Childhood Interests company, its decorativeness is a feature.

In tests made on the spring for its adaptability to juvenile exercising, this company hung an $11^1/_2$-lb. weight on one end of it, left it in place overnight and examined it next morning. It had stretched about half again its own length, but 45 minutes after the weight was removed, it had regained its original length and elasticity. The company says that as yet the spring has not been perfected for use as a compression spring, although it is undergoing additional tests in the laboratories of an eastern university and the full extent of its possibilities cannot be determined until these tests are completed.

Another interesting development made by the same company is an all-plastic interlocking PX tubing, although this is

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still in the experimental stage. Manufactured at present of ethyl cellulose (it can also be made of cellulose acetate butyrate), the tubing is formed by narrow continuous strips, with interlocking joints which make it completely flexible and able to expand and contract slightly in length. Tubings up to 3 in. inside diameter have been successfully produced.

The present run is a tubing of rectangular shape, about 6 in. wide and 1 in. high at the center, tapering slightly at the ends. Large-scale production of the tubing must await test of the material's strength and temperature resistance. It has the obvious advantages of saving metal and saving weight, being approximately half the weight of the stainless steel flexible tubing now being used for ammunition feed chutes.

Credits—Material: Tenite II, molded by Schwab & Frank, Inc.

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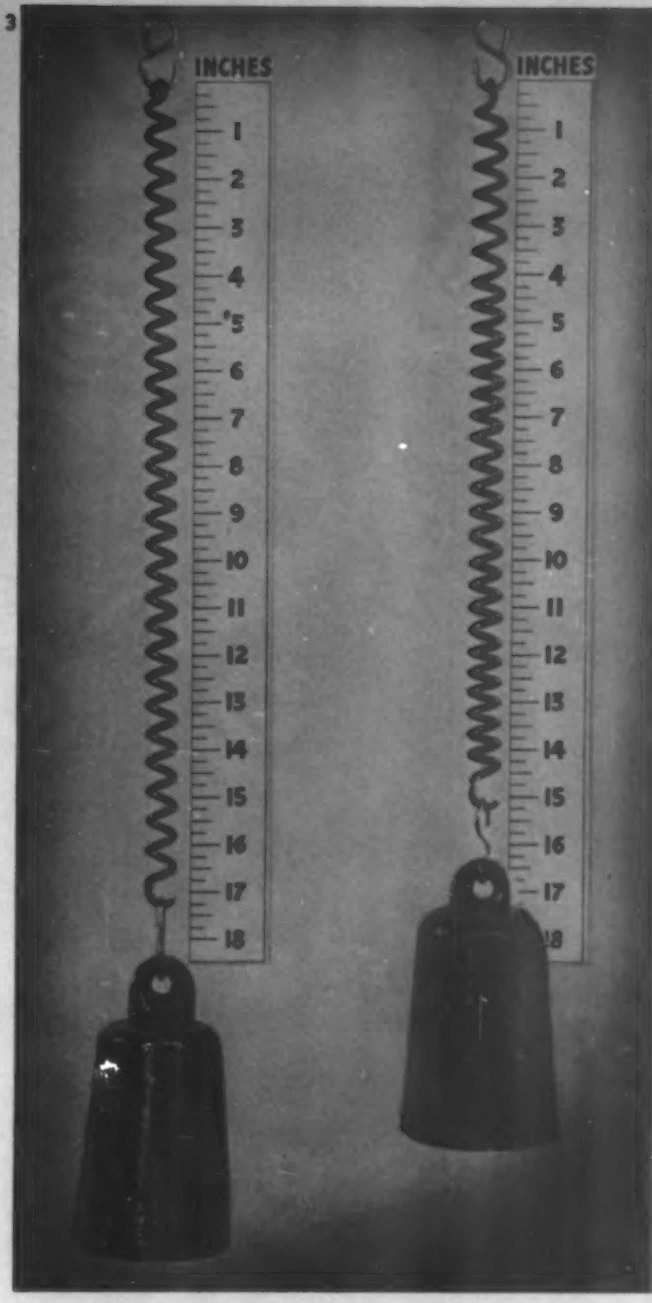

2—Tension springs of cellulose acetate butyrate are extruded in continuous lengths. 3—At left, thermoplastic rod which has been coiled on a mandrel, heated and chilled. At right, section cut from same piece has been given added tension by a special process, which accounts for its different reaction when weight is applied. 4, 5—Child's exercising equipment is suspended by springs of the specially treated plastic material

PHOTOS, COURTESY CHILDHOOD INTERESTS, INC.

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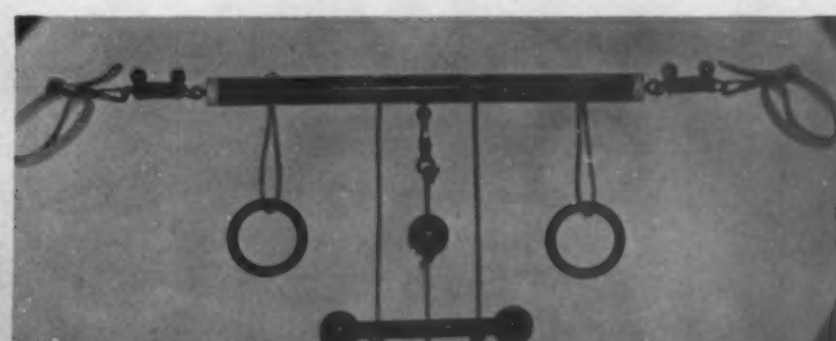

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PLASTICS IN REVIEW

1 Believed to be the smallest parts ever injection molded, these tiny Lumarith studs are replacing metal as fastening devices for jewelry-marking tags. Injection molded by Stirling Plastics Co., the minute cellulose acetate buttons are reported to be doing an efficient job, and no metal is diverted from important military uses. Celluloid tags by Arch Crown Tag & Stamping Co.

2 At the plants of North American Aviation, Inc., transparent Plexiglas escape hatch doors are rigidly inspected for flaws and imperfections prior to installation. This rigid, lightweight material with its extraordinary optical properties, and its resistance to wind and weather is finding its way into larger sections of aircraft where the strategic importance of all-around visibility is attained by these acrylic enclosures

3 For increased accuracy in the cutting of tapered metal parts turned on a lathe, and for stepped-up production of parts for military production, the Monarch Machine Tool Co. has installed a magnifying lens of Lucite on the taper attachment of its lathes. The methyl methacrylate lens magnifies the gradations and assists the operator in cutting tapers to within one ten-thousandth of an inch or less. It bars grease and dirt, and is said to be reducing breakage and replacement costs considerably

4 The excellent insulating properties and high dielectric strength of Durez molding compounds are brought into play in this switch body for the Dayton Pump and Manufacturing Co. In the final assembly this part is concealed from view, eliminating the necessity for a high gloss finish. Practically no finishing is necessary, and only a few threading operations are required to supplement the main molding job. The mounting stud is molded integrally. Other change-overs in the switch body include the valve seat, stuffing box and nut, and piston leather spacer. It was not necessary to change the shapes of these parts to adapt them to molded plastics. Plastics Moldings Corp. does the molding

5 Warning signal units for fuel tanks used by the Army and Navy Air Corps are availing themselves of the transparent qualities of Marblette cast phenolic. The clear plastic shield which fits around a small light bulb has a dual function: it serves both as an electric insulator and as a filter, insuring a glare-free glow when the warning lights flash to indicate a low fuel supply. Manufactured by the Liquidometer Corp., these units are nonflammable and have a degree of tensile and impact strength sufficient to withstand even unusually tough service conditions

6 For that community washing machine in the apartment house laundry, a streamlined coin meter molded of lustrous Durez. Handsome and sturdy, the housing will retain its gleaming finish come what may in the way of steam, soap, hot or cold water, dirt, solvents, etc. The main body of the meter, which contains the operating mechanism, is molded in one piece by Pal Tool Co., and with the top forms a completely enclosed housing. The molded Durez switch lever in the front has a short shank to which a metal

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sleeve is pinned. A simple turn of the switch delivers the coin deposited in the top slot to a container below, and starts the mechanism operating

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7 Symbol of election campaigns, fund-raising drives, contests or just "belonging," the Celluloid button is also making its contribution to the war effort. Every type of legend from an exhortation to "Remember Pearl Harbor" to the proud "I Bought War Bonds" appears on these buttons. Colorful, water-resistant, easily machined and durable, cellulose nitrate plastics are helping to foster and maintain civilian morale

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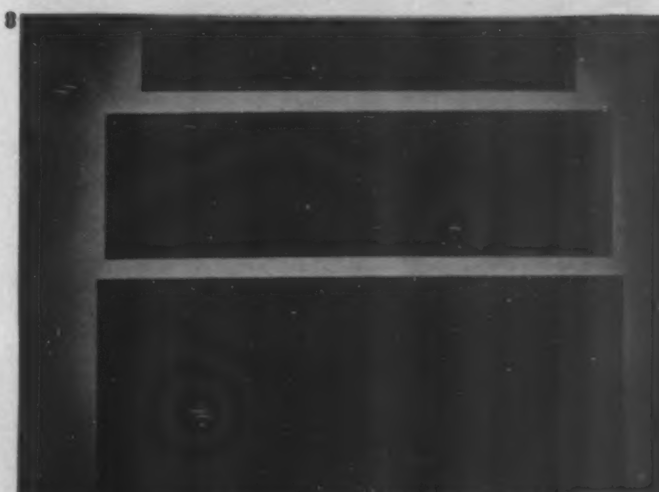

8 Have you ever watched a tray-laden waiter kick open the door between the serving room and the dining room in a hotel or restaurant? No door could stand up against such conditions of use without considerable damage and deterioration after a brief interval. Equipped with these durable Formica kick and push plates, however, dining-room and institution doors will be able to take unlimited abuse over long periods of time and emerge without a sign of wear or damage. Machined from laminated sheet, this non-metallic material is not brittle and will not chip or crack under severe impact. Non-porous, the smooth, colorful plates will not absorb stains or react chemically with ordinary liquids. They are $^1/_8$ in. thick, with beveled edges, and have countersunk screw holes for simple attachment to door surfaces

9 Electrical connection and assembly devices equipped with Catalin handles, which have been machined from rod stock, are helping to keep production in full swing. Colorful for quick and easy identification, durable for rough service conditions, impact resistant and non-flammable, these cast phenolic handles are making a small contribution to efficiency and uninterrupted production by cutting down maintenance time

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10 Drawer pulls, label holders and knobs for the modern filing cabinet are injection molded of tough, stable cellulose acetate. These items were originally designed in brass, for which this non-tarnishing material has proved more than an adequate replacement. The Tenite handle and label holders are each molded in a 4-cavity mold, the knob in an 8-cavity mold, all by American Insulator Corp. for Art Metal Construction Co.

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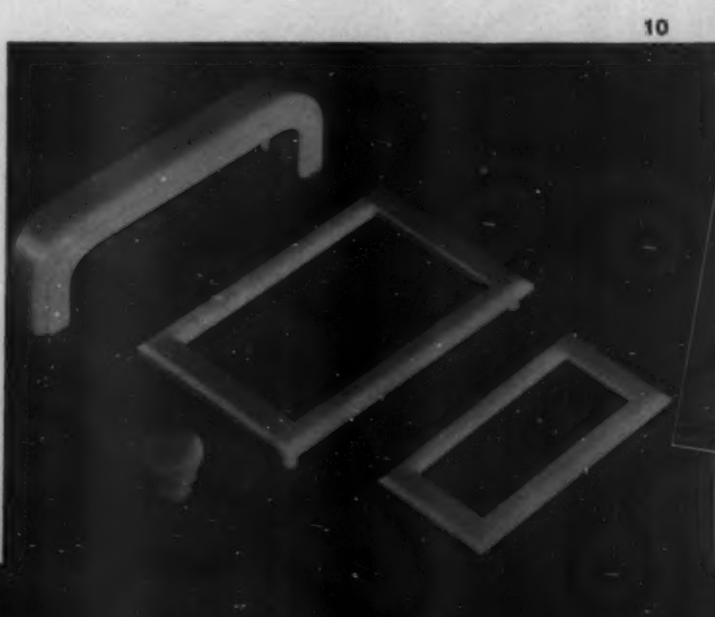

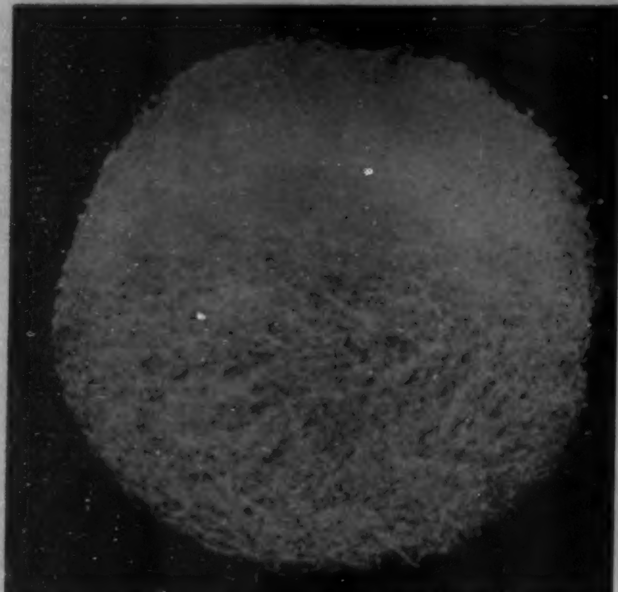

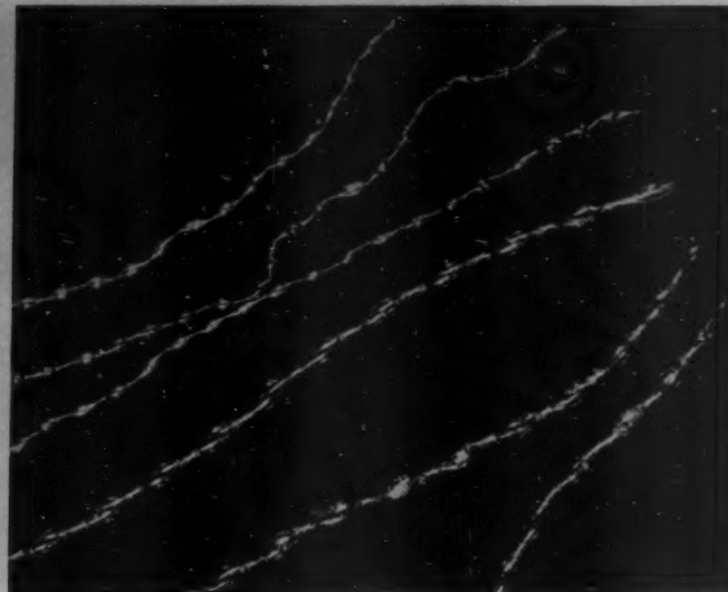

PHOTOS, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.

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1—A tightly packed mass of bubble strands looks like a mammoth snowball. 2—Strands of the cellulose product resemble transparent beads. Buoyant and resilient, the material weighs 1.5 lb. per cubic foot

Floating on air

When our Japanese adversaries severed the supply route from Java, one of the seeming irreplaceables cut off with it was kapok fiber, which has its origin chiefly in the seed pods of a Javanese tree. Resilient, buoyant, water-resistant and moistureproof, this material had its greatest peacetime outlet as stuffing for mattresses and pillows, life preservers and life jackets. In wartime, its potential uses were multiplied tenfold, and its lack might have created a serious situation.

Such an emergency has, however, been diverted by the ingenuity of American chemists who have just perfected a new material which not only promises to replace kapok, but has also demonstrated its possibilities in applications where kapok had decided limitations.

Chemically this new material, called Bubblfil, is comprised of the same basic ingredients as Cellophane or rayon—that is, regenerated cellulose made by the viscose process. The syrupy viscose material is extruded through a single spinneret hole of fairly good size, and a small amount of air is injected into it at regular intervals just as the filament is coagulated by the acid bath in which it is spun. The result is actually a tiny Cellophane package containing air. The size and spacing of the streamlined air bubble may be adjusted and arranged according to choice and expediency, but the whole unit resembles a string of transparent beads, with each individual component running a little longer than 1/4 in., or approximately three "beads" to the inch.

The resilience and buoyancy of this new material points to a wide range of possible applications both for immediate war uses and for eventual peacetime purposes. Tests are reported to have demonstrated that it is not only fully as buoyant as the imported kapok but also does not lose its ability to float so rapidly during prolonged immersion in water. It has proved entirely satisfactory as a replacement for kapok in aviation tow targets where a buoyant material is essential as a means of keeping the target afloat after it has been shot down.

The new product has been considered for life jackets of the type worn by U. S. Navy personnel, and it has been tried in air compartments of life boats and life rafts where kapok is no longer used because of sharply limited supplies. Bridge pontoons, formerly filled with sponge rubber, may now depend upon this new material for their floating power. Bullets and falling débris are said to have a negligible effect upon craft that are floated by the cellulose bubbles.

Neither kapok nor the cellulose material can be considered non-flammable, but the new air bubbles will not ignite when struck by tracer bullets, and it is possible to render the material entirely flame-resistant by chemical treatment, a factor of considerable importance for military applications.

Tightly packed, these Cellophane-wrapped air packages weigh about 1.5 lb. per cubic foot, and a cubic foot will support 20 to 30 times its weight in lead. Less than 3 lb. of the material are sufficient to keep a man's shoulders out of water. The bubbles cannot be broken by squeezing, nor will the effects of extremely low pressure at high altitudes cause them to rupture. Laboratory tests have demonstrated that they remain intact at altitudes over 50,000 ft., and that extremes of temperature will not affect them to any degree. Heating for three days in air at temperatures above 200° F. and subsequent chilling to −28° F. had no effect on the bubbles and they emerged unbroken.

The material is said to be so tough that its buoyancy remained unimpaired when cheesecloth bags filled with it were subjected to an impact of 79 ft.-lb. per sq. in., equivalent to the impact sustained by a life jacket (*Please turn to page 150*)

Sealing jars, modern style

The chemist set out to find a new product, and wound up in a new business which is a wartime manufacturer's dream. It uses strictly non-critical materials of which there is an unlimited supply; satisfies a large-volume civilian demand so essential that it has the Government's enthusiastic backing; and employs existing production machinery of almost unlimited capacity.

All this results from the discovery by Harry B. Denman, chief chemist of the Detroit Gasket & Manufacturing Co., of a new plastic material peculiarly applicable as a jar-closure sealing ring for both home and commercial canning of foods.

Next year, housewives alone will use 27,000,000 gross of rubber jar rings and commercial canners from eight to ten times that number, according to the Department of Agriculture. With tin cans virtually eliminated and the entire food-packing industry now turning to glass containers, the need for closures next year is multiplied many times over. Naturally the Government has been searching for a practical substitute that would release for war uses the millions of pounds of rubber usually absorbed by essential food packing.

Although synthetic rubbers might substitute, the Government has not made them available for the purpose, and has sought to avoid doing so, since even the synthetics—for the time being at least—are reserved primarily for war uses. Other substitute materials have not measured up to the toxicity and other tests necessary for products used for food packing. But thus far the new jar ring has stood up under every test applied by the Department of Agriculture and by responsible packers in actual canning operations.

The material is described as a flexible, thermoplastic composition. Because it is not yet patented, the company will not divulge the exact constituents of the formulation. However, it does claim that at the present time the raw material is readily available in unlimited quantities. The composition includes certain processed vegetable oils, chiefly corn oil, and a petroleum byproduct.

Thus the product differs importantly from other similar synthetics in which corn is used only after being distilled to alcohol. The material definitely does *not* have an alcohol base and none of its constituents is in any way critical at the present time. The petroleum byproduct is not of the variety now being used in the manufacture of synthetic rubbers, but is one for which there is at present no pressing demand. The material was discovered by accident while the company, previously concerned chiefly with the production of gaskets and similar devices for the automotive and aviation industries, was searching for a practical substitute for rubber gaskets.

The jar-ring plastic, which the company designates merely as its No. 77 closure material under the trade name of "Dee-Gee," is not practical for engine gaskets or similar applications. However, another plastic is now being developed along more conventional lines which may be used for braided rubber hose, packing and molded goods.

A characteristic of the material is that it "flows" slightly

1—Both domestic and commercial canners now use glass jars with edge type closures. The new flexible, thermoplastic composition forms suitable rings for these jars. 2—Edge type closure can be punctured easily to release vacuum, making jar opening quick and painless

PHOTOS, COURTESY SUPER-SEAL CONTAINER CORP.

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3—For home canning, the new closure may substitute for rubber rings when glass top-seal jars are used with metal screw rings. 4—Side-seal and top-seal commercial closures using the plastic rings. The side-seal type (right) is cut from extruded tubes, the top-seal die-cut from calendered sheets of the material

under heat or pressure—a quality which first suggested its use as a jar seal. It has proved superior to rubber in sealing qualities, according to the company, in that it tends to "lock" itself by the "flowing" action at temperatures of 150° to 175° F., and will withstand sterilization temperatures up to 275° F.

The company recommends the closure for all three of the common commercial canning seals—top seal, side seal and edge seal. It does not recommend it for such shoulder-type seals as the old-style, zinc-top Mason caps, inasmuch as the sharp edge of the lid may cut through, affect the appearance of the product and possibly cause leakage.

However, the ring is quite feasible for home canning with the more modern porcelain or glass cap which is fastened down over the rubber top seal with a metal screw ring. In fact, with the plastic ring the seal is so perfect at ordinary hot canning temperatures that the metal ring may be removed after the jar cools and used over again. The ring is particularly effective as a vacuum seal under commercial methods. In some forms of packing in glass jars, a vacuum as high as 25 pounds is created.

Very important to commercial packers is the fact that this replacement material, in combination with the new all-glass containers now on the market, removes the last critical material from their requirements. Neither metal nor rubber is necessary in this form of pack.

Figures 2 and 3 show two types of glass container on which the new sealing device is used. One is an edge-seal jar particularly designed for commercial packing and the other a top-seal home canning jar. In either case, the finished package requires no metal or rubber. The vacuum seal is readily broken and the lid removed by piercing at a designated point with an ice-pick or screwdriver.

In the canning operation, tests have shown that best results are obtained if the closure is heated to 150° to 175° F. and applied hot. This is not necessary in home canning, as the entire package is hot when sealed. In commercial canning, however, it may be necessary to devise a method to heat the closures as they are delivered through the sealing machine. In one type of machine now in use, this has been accomplished by passing a steam coil around the stack of closures so that the closure is brought to the desired temperature at the point of application to the container. The same results can be obtained by electric heating elements in place of steam.

The sealing ring is resistant to weak acids (including vinegar) and alkalis. However, it is not oil resistant and cannot at the present time be used for salad oil preparations and similar materials.

As to toxicity and taste, the plastic has been tested in food for home consumption by cooking it directly in with the food. When the food was eaten, the plastic could be detected but its taste was claimed to be no more objectionable than that imparted to food by a rubber ring.

The material softens at boiling temperatures, but it has proved satisfactory in tests where it was put through a beer pasteurizer as liner for a metal crown cap. It keeps its seal when the goods are stored at refrigerated temperatures. At present the use of the plastic as a seal for vacuum pack coffee is under test. When stored in direct sunlight the material proves satisfactory up to 175° dry heat under normal humidity conditions.

An important advantage of the new plastic is that it requires no new machinery for its production, either in the raw or finished state. On the contrary, it makes use of existing machinery which is now largely idle, or at most, not greatly extended. There is no apparent reason why sufficient canning rings cannot be made of this material to supply all commercial and home canning needs in 1943.

The manufacturing process is described as follows: The raw ingredients are compounded and milled in standard equipment such as Banbury (*Please turn to page 148*)

Civilian incendiary bomb extinguisher

1

PHOTO, COURTESY SINKO TOOL & MFG. CO.

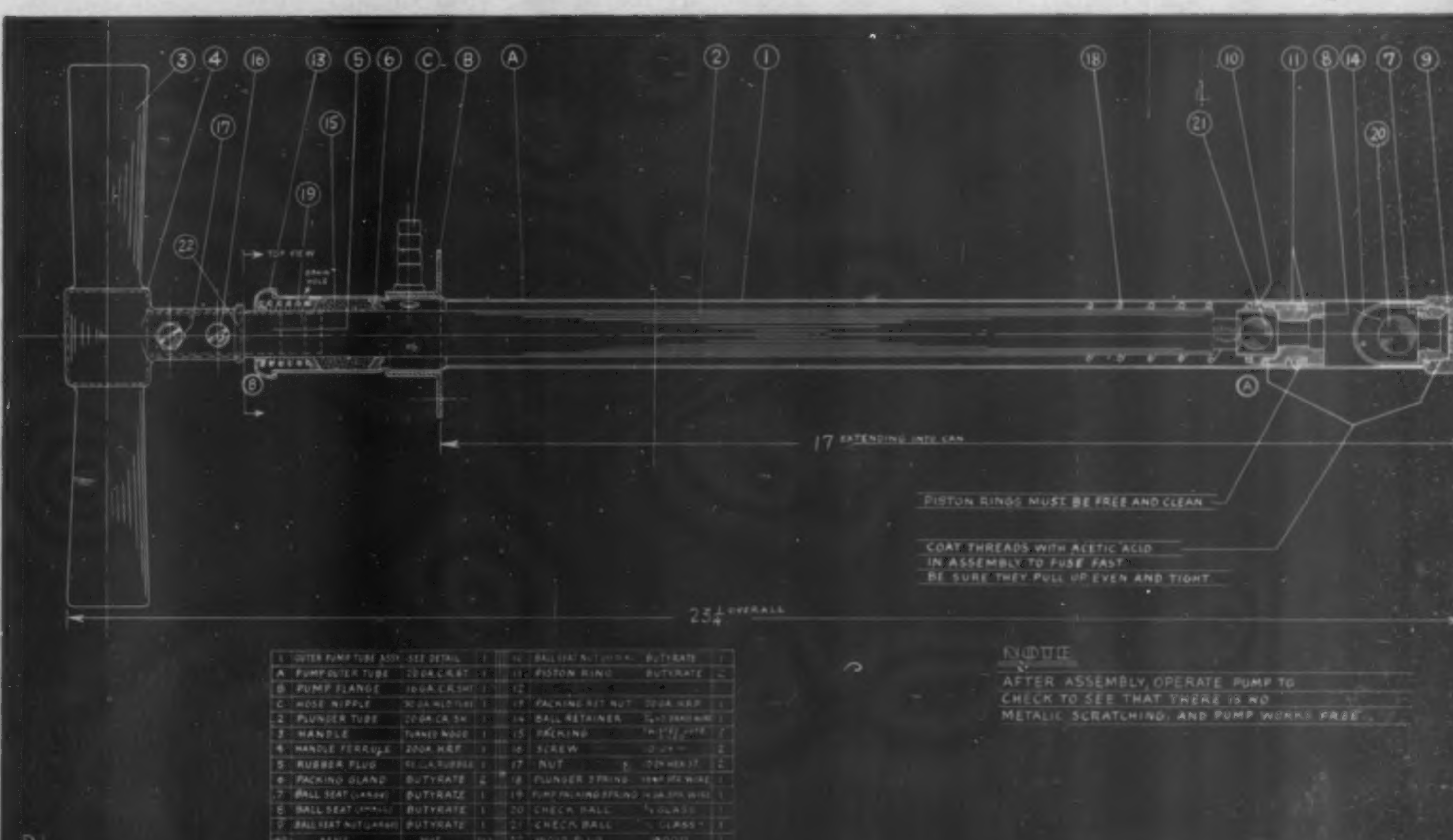
OBVIOUSLY, any national protection against the incendiary bomb menace must be on a huge scale. Fires resulting from these bombs must be extinguished quickly before they have a chance to spread. Extensive conflagrations can be avoided most efficiently if all householders are supplied with proper fire-fighting equipment.

The problem of finding the necessary materials for the construction of this equipment is enormous, and is further aggravated by the fact that parts coming in contact with water are normally made from non-ferrous metals to avoid rusting and corrosion. Not only the materials but the equipment, time and man-power for manufacturing such pumps are now unavailable. Here again, as in so many similar instances, molded plastics offer a highly satisfactory solution.

Much has been said and written around the standard stirrup pump which is used in conjunction with a pail of water, but very little has been mentioned with reference to a complete self-contained unit like that shown in Fig. 1. This pump has a capacity of 4 gallons of water and a 10-foot hose

1—Civilian incendiary bomb extinguisher, which has 7 different plastic parts. 2—Schematic layout of completely assembled pump unit. Legend identifies parts

2



equipped with a nozzle which shoots a stream of water up to 50 feet, or sends it out in a spray covering a wide area.

Figure 2 shows the complete pump assembly. There are seven different plastic parts in this pump, which are marked with identical letters and numerals on each of Figures 2, 3, 4 and 5 and identified in the legend below Fig. 2.

Part No. 6 is the packing gland, and two are required for each pump assembly. These glands are used to compress packing around the pump shaft.

Part No. 8 is a small ball seat, into which is assembled part No. 10, which is a ball seat nut. Also assembled on part No. 8 are two split piston rings—part No. 11. This assembly of parts No. 10, No. 8 and two No. 11's makes a complete pump plunger, with the split piston rings sealing the pumping pressure against the inside diameter of the pump.

Part No. 9 is a strainer or large ball seat nut which, when assembled with part No. 7 (large ball seat), not only acts as a strainer but in addition serves as a ball seat sealing device.

The pump is also equipped with a hose nozzle, part C.

All the above-mentioned parts are injection molded of cellulose acetate butyrate. Figure 8 shows the nozzle parts just as they come from an 8-cavity injection mold. All the other six butyrate parts are molded in one 16-cavity combination mold.

Mold drawings showing the general layout of the mold, as well as various unusual mechanical movements, are shown in Fig. 5.

Figure 4 shows completed parts, all of which are made in the 16-cavity combination mold. Their numerical identification corresponds to that of the blueprints for purposes of easy identification.

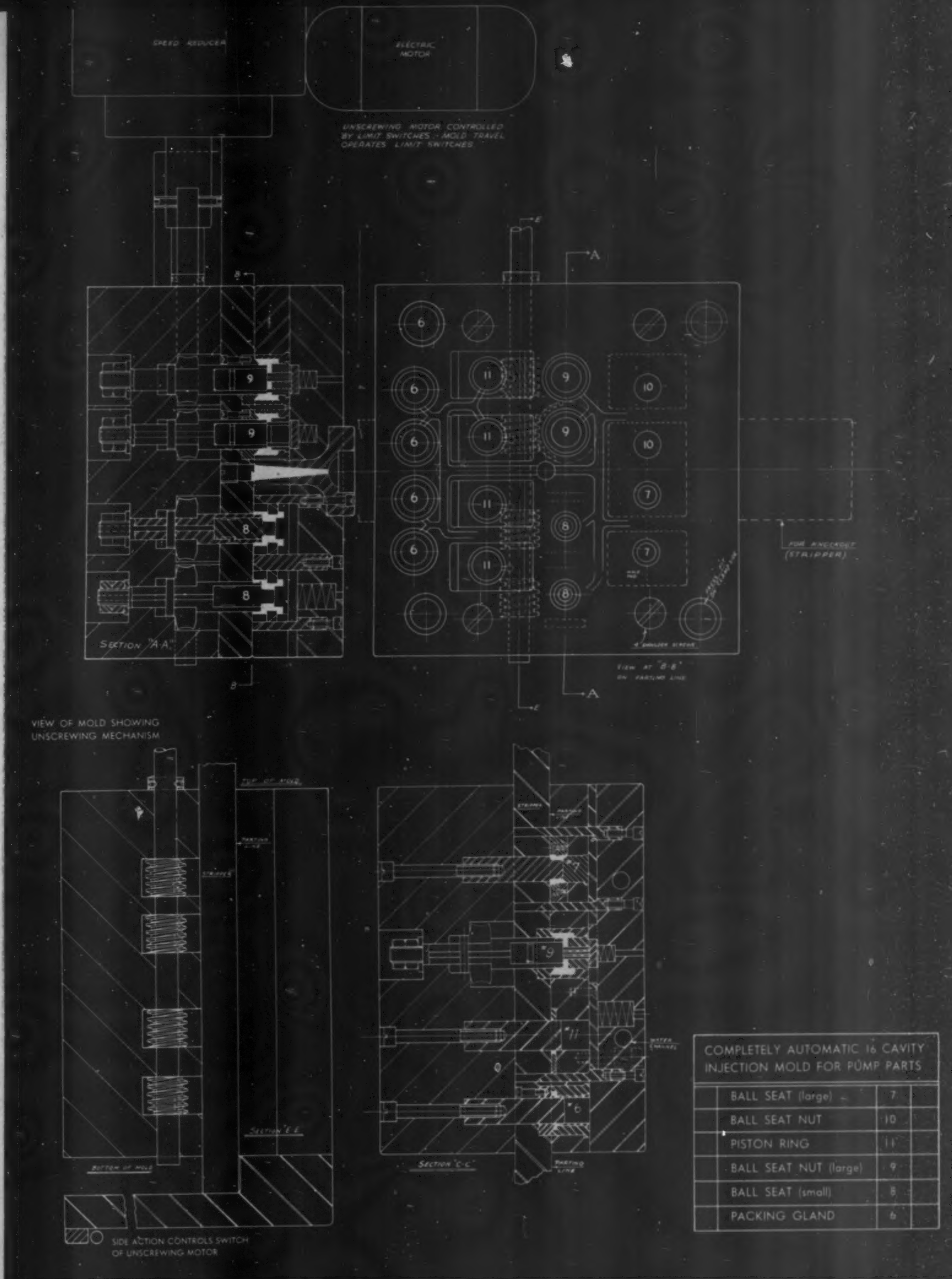
This "trick" mold not only opens and closes in the orthodox manner, but several other motions are incorporated in the mold design. Piece No. 8 and piece No. 9 have internal

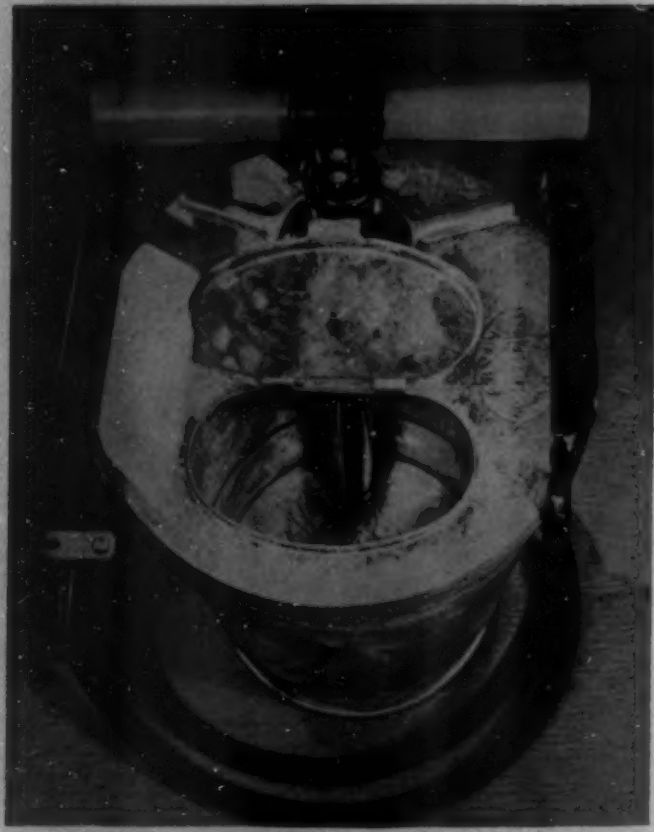
PHOTOS, COURTESY SINKO TOOL & MFG. CO.

3

3—The large and small ball seats and ball seat nuts, both showing the intricate molding of internal and external threads and undercuts. 4—Pump parts just as they are broken from the sprue, and before gates are finished off. 5—Mold layout shows automatic unscrewing method, the switch for controlling it, and the method of splitting cavities for undercuts

4


SPEED REDUCER
ELECTRIC MOTOR
UNSCREWING MOTOR CONTROLLED BY LIMIT SWITCHES - MOLD TRAVEL OPERATES LIMIT SWITCHES
SECTION "A-A"
FOR KNOCKOUT (STRIPPER)
VIEW AT "B-B" ON PARTING LINE
VIEW OF MOLD SHOWING UNSCREWING MECHANISM
TOP OF MOLD
PARTING LINE
STRIPPER
SECTION "E-E"
BOTTOM OF MOLD
SECTION "C-C"
SIDE ACTION CONTROLS SWITCH OF UNSCREWING MOTOR
COMPLETELY AUTOMATIC 16 CAVITY INJECTION MOLD FOR PUMP PARTS
BALL SEAT (large) 7
BALL SEAT NUT 10
PISTON RING 11
BALL SEAT NUT (large) 9
BALL SEAT (small) 8
PACKING GLAND 6



6 threads. As the mold begins to open, the ram trips a limit switch that opens a circuit, starting an electric motor that is directly connected with a speed reducer. This speed reducer is connected to a shaft on which are mounted four worm gears that mesh with gears mounted on the threaded plugs.

This unscrewing motion continues until the ram reaches its extreme open position. At this point it strikes another limit switch, closing the circuit and stopping the motor. The motor and the threaded plugs to which it is indirectly connected remain stationary until the injection cycle is completed.

Piece No. 9 not only has internal threads, but also has a heavy undercut shoulder. The sections of the cavities molding this undercut are split and open automatically by a cam action as the mold opens.

Pieces No. 7 and No. 10 have external threads. These cavities are completely split, and also open by a cam action which is actuated by the opening motion of the mold.

7 When all these various unscrewing and cam motions have taken place, a stripper plate, shown in both section "E-E" and section "C-C" in Fig. 5, ejects all parts from the mold. This stripping method eliminates all projections or depressions as well as fins, which are inherent when knockout pins are used for piece injection.

It will be noted in the photograph of piece No. 11 (the split piston ring, in Fig. 4) that the split portion is actually an undercut. However, these piston rings are flexible enough so that when the stripper plate pushes them from the force plugs they spread and snap past the portion of the force plug molding this split.

This intricate mold is being operated on a 2-oz. press, and the total weight of the 16 parts exceeds the rate of press capacity by 25 percent. Normally this unit would be operated on equipment with a capacity of at least 4 ounces. Heavy injection units are now on the critical list, however, and it was necessary to devise ways and means of using the smaller equipment.

It is obvious that skill and ingenuity are used in the design of this mold. Some molders avoid the use of various automatic side pull and unscrewing motions, but this job is a perfect example of a case where the use of unusual mechanical movements has produced a complete and fully automatic mold, with three separate and distinct motions operating at the same time.

The cellulose acetate butyrate used for molding the parts of this bomb extinguisher gives them excellent dimensional
8 stability. The material absorbs very little water, and has a slow burning rate—both of which properties make it suitable for elements of a piece of fire-fighting apparatus. Its light weight is another advantageous factor, since the bomb extinguisher is constructed to be carried by hand.

Credits—Material: Tenite II. Molded by Sinko Tool & Mfg. Co. for Noblitt-Sparks Co.

6—One complete shot of pump parts from the 16-cavity mold of a completely automatic injection molding machine. It splits automatically to release undercuts and external threads, unscrews automatically to release internal threads, and the undercut splits on piston rings strip automatically. 7—Inside view, showing pump mounted in container. Fastened to nozzle is attachment for delivering water in a spray. 8—One complete shot from the 8-cavity injection mold for the nozzle of the hose

Design fundamentals for phenolics

by J. A. PETHO*

THE present defense effort is taxing the output of every established metal, and in many instances the demand is greater than the production facilities available either now or in the immediate future. To overcome this condition and eliminate the resulting bottlenecks it became necessary to investigate the possibilities of other materials heretofore not considered for structural applications.

Among the materials investigated were plastics in general. Of this group, laminated or molded fabric-base phenolic plastics, already used extensively for electrical and mechanical applications, were quickly recognized as the plastic offering the greatest possibilities of solving the structural problems. The mechanical applications of phenolic plastics include cam shaft gears in internal combustion engines as well as roll neck bearings in steel mill applications, in both of which installations they were the premier material standards.

In addition to their proved mechanical strength, phenolic plastics have another very important characteristic, namely, their low specific gravity—approximately $^1/_2$ that of aluminum alloy—which places this material on a competitive basis with lightweight metals. For an easier comparison, let us consider the following table showing comparative physical strength figures.

TABLE I.—STRENGTH OF PHENOLIC MATERIALS

	Aluminum castings	*Molded canvas base laminated*	*Phenolic plastics macerated*
Specific gravity	2.56	1.4	1.35
Weight, cu. in.	.0924	.05	.05
Tensile strength	15,000 p.s.i.	10,000 p.s.i.	7,200 p.s.i
Compressive strength	12,000 p.s.i.	35/45,000 p.s.i.	20/30,000 p.s.i.
Modulus of elasticity	11,000,000	1,000,000	1,000,000

The figures in Table I, comparing plastics with aluminum, indicate a material which for the same weight has a cross section almost double that of aluminum. If we consider the tensile strength of the two materials, we find for the same weight a gain of 3300 p.s.i. in favor of laminated phenolic plastics. Because the compressive strength of laminated phenolic plastics is superior even at unit areas, we must consider this material as an improvement over many of those used for aircraft construction. We must also realize that laminated phenolic plastics are not so rigid as cast aluminum.

In considering the characteristics of phenolic plastics, we arrive at the conclusion that design based on knowledge of the material is essential for a successful installation. In other words, we cannot in most instances use phenolic plastics for the same forms and dimensions as those designed for aluminum. Even when we take the difference in specific gravity into consideration, we must design for more than a straight increase in cross-sectional area of the piece in question. If the member is under a straight compressive loading at all times, theoretically no increase in cross section over the aluminum section is required. When the part is under a tensile loading, a cross-section increase over the aluminum is

* Research engineer, Continental-Diamond Fibre Co.

PHOTOS, COURTESY CONTINENTAL-DIAMOND FIBRE CO.

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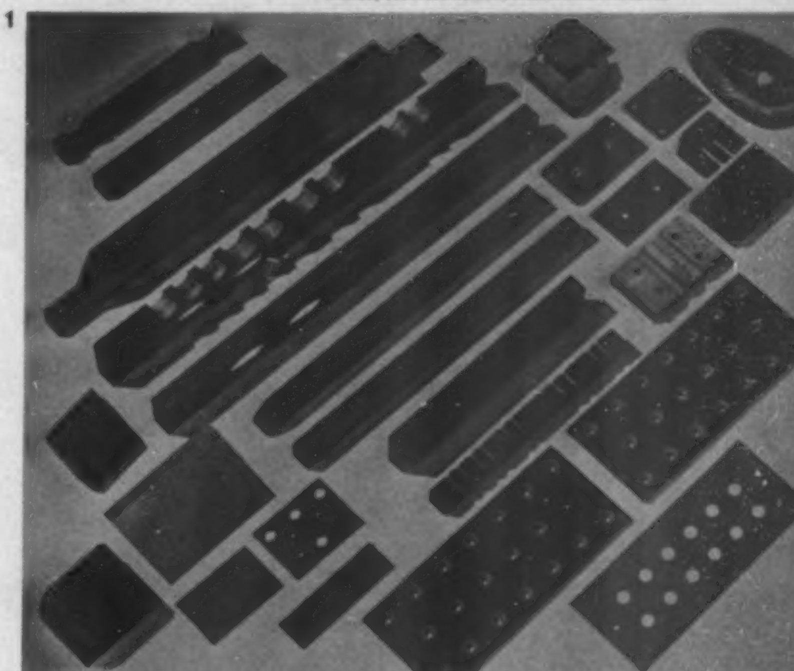

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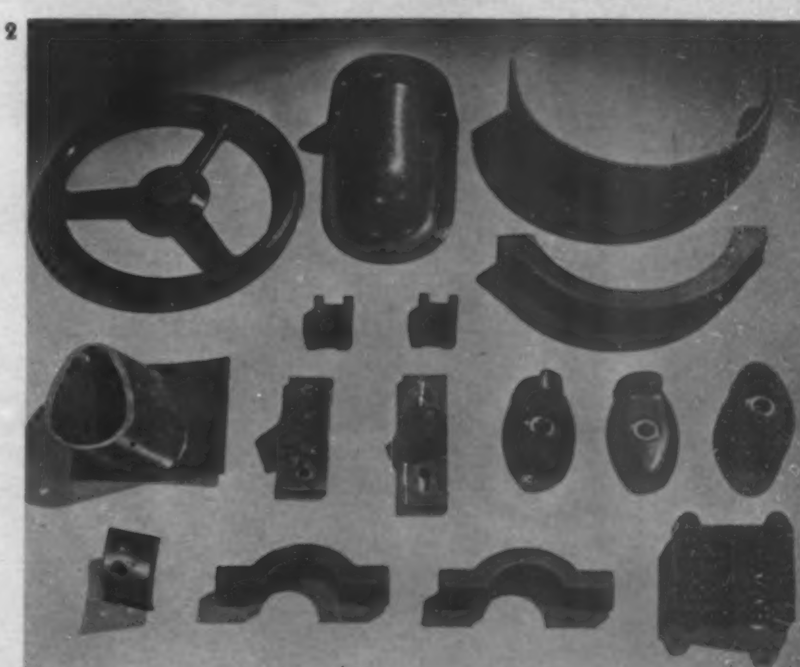
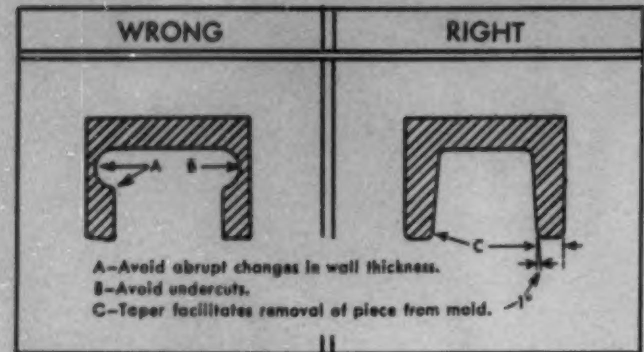


1—A group of airplane parts fabricated from laminated fabric plastics. 2—Another group of plane parts, all molded from macerated and laminated fabric plastics

3



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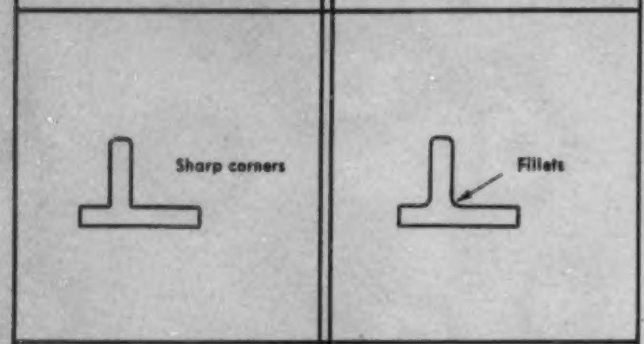

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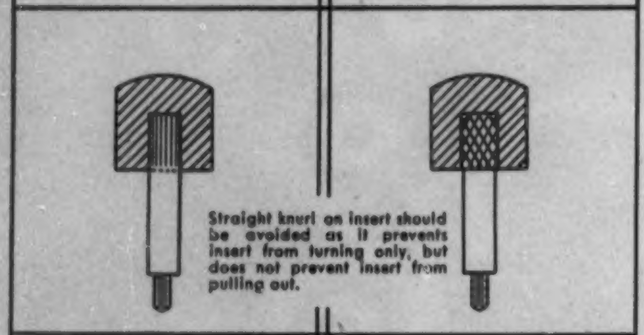

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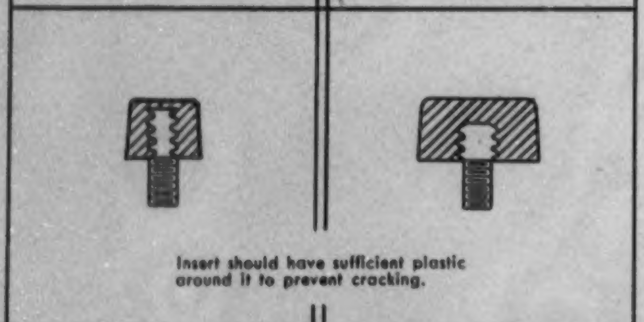

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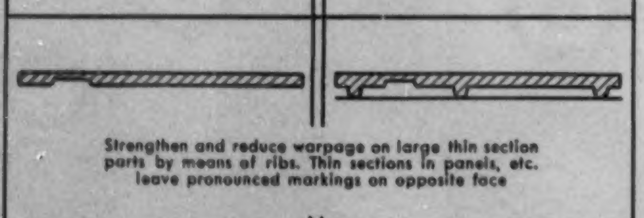

recommended up to the point of equal weight. When rigidity is of major importance, in addition to the cross-sectional increase, a design employing ribs is to be used.

Phenolic plastic parts can be either machined from sheets, rods, tubes or molded to the required shapes. Molded parts are usually made from macerated canvas, although laminated or a combination of laminated-macerated construction is frequently molded. Successful molding of plastics is dependent upon the design of the part, and therefore the knowledge of molding possibilities is absolutely essential for a good design. Molding can be either with high pressures or with low pressures, using mold designs most suitable for the job.

In general, high-impact plastic molding can be divided into four groups, based on the molds employed—Group 1, compression molds; Group 2, flash molds; Group 3, filler plate molds; Group 4, transfer molds. These types of molds are shown in Figs. 8-11 on this page.

Group 1, compression molds, are the most frequently used for high-impact plastic molding. These molds can be further divided into positive and semi-positive types. The difference between the two is that a positive type mold has no provisions for the excess material, whereas a semi-positive type mold is provided with bleeder openings for the excess material. Both types are 3-piece molds comprising a ring and top and bottom plates. The top and bottom plates receive the molding pressures and transfer their forms to the plastic. The purpose of the ring is to retain the material and form the side wall of the plastic during molding operations.

Group 2, flash molds, are generally considered as two-piece molds consisting of top and bottom plates but no ring. The excess material is flashed off through the parting line of the two plates. The plastic charges used in this type of mold should be preformed in order to reduce the bulk factor and to eliminate excessive flash at the parting lines necessitating a preforming mold. Flash molds must be designed with lands or stops to control the dimensions of the molded piece. Careful consideration must be given to the size of the land. If the charge is insufficient, all the mold pressure will be absorbed by the land; and if the land area is too small for the pressure, the mold will be damaged. On the other hand, if the land area is too large, a stagnation (*Please turn to page 142*)

3–7—Drawings illustrating right and wrong way of designing molded parts. 8—The positive mold has no means of expelling excess charge, and its entire pressure is therefore exerted on the material. 9—Flash molds permit excess charge to be expelled or flashed off between mold members. 10—Necessary design of flash type mold when added loading space is needed. 11—Method of transferring the softened material into a closed mold by means of a pressure pot and orifice

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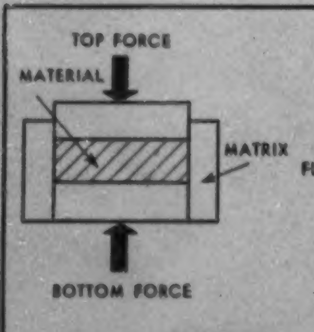

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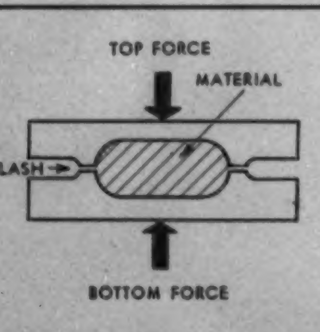

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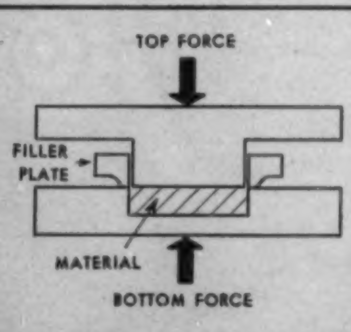

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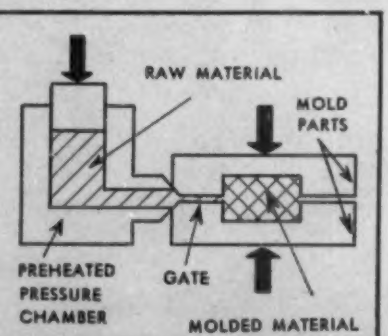

DRAWINGS, COURTESY WESTINGHOUSE ELECTRIC & MFG. CO.

Signal Corps mast-raising

It has long been a U. S. custom for a man's neighbors to gather at his farm when he is ready to build a barn. The building materials have all been assembled, and it takes but a few hours for the group of men, all working together, to raise the new barn. Equally speedy is a mast-raising by the U. S. Signal Corps but, unlike the time-honored barn raising, it requires the attendance of only two men.

For a 75-ft. mast capable of being erected in a hurry without the combined efforts of a large crew of helpers, the Corps needed one made of materials that were light, easily assembled and not difficult to transport. Molded resin-bonded plywood met all these requirements, and had the strength necessary for this type of application. It cannot rust, corrode or oxidize, and is chemically inert.

Use of molded plywood instead of tubular metal for these masts is an innovation, and the method of mast-raising is unique. Two men can raise this mast and have positive control of it the entire time. Figure 1 clearly shows the system of guy wires, tubular plywood fulcrum and block and fall which make this erection possible in any kind of weather.

Two sleeves mounted in a hinged assembly on the base are shown at the right of Fig. 1. Before erection, the base of the mast is mounted in one sleeve and the base of the fulcrum in the other (see Fig. 2). Thus, with their bases securely fastened in the grounded sleeve, no slipping can occur at the bottom of either the fulcrum or the mast. Figures 3 and 4 show the mast on its way up and after it has reached its final upright position.

Credits—Material: Molded Weldwood, by U. S. Plywood Corp.

PHOTOS, COURTESY U. S. PLYWOOD CORP.

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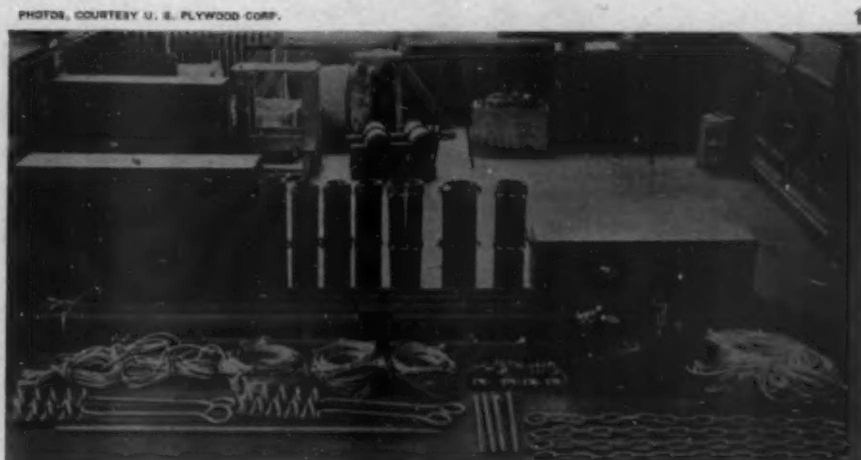

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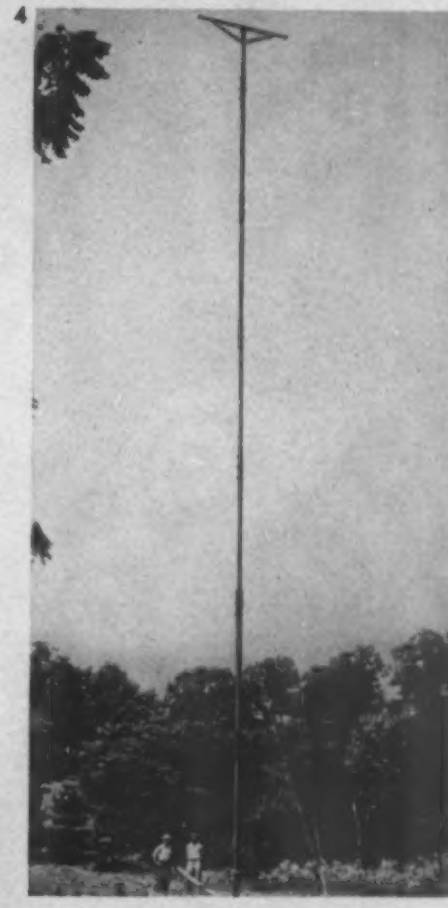

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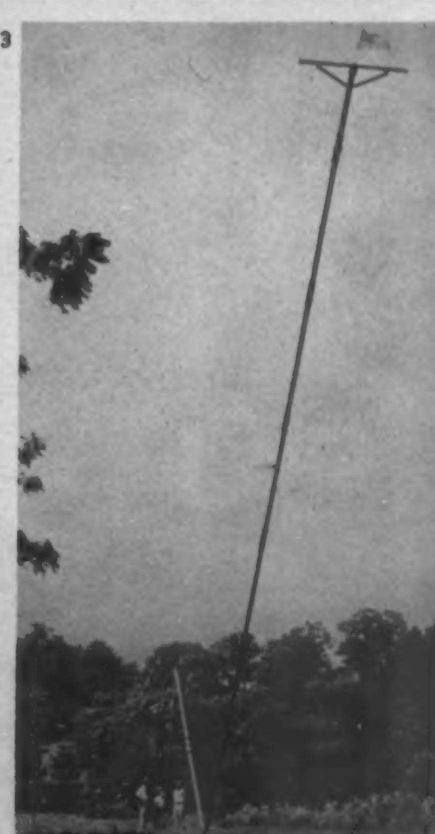


“We chose Plaskon

Planes of paper

1


2


3


PAPER is the base material of a plastic which, as it is now conceived, may prove a revolutionary factor in the construction of airplanes. The paper used in the process is made from a special wood pulp which is available in almost unlimited quantities. This paper, after being impregnated with a special phenol-formaldehyde resin, is ready for molding. Because of the critical relationship which the product may ultimately bear to a vital wartime industry, the exact nature of this plastic and details of its composition and production have been withheld.

Experimental data thus far obtained in laboratory tests indicate that the product is twice as high in tensile strength as any paper laminated plastic heretofore produced. It is also claimed for this new material that it equals aluminum in tensile strength on a weight basis, that it is highly resistant to moisture, remains stable at both high and low temperatures and is more resistant to scratching and denting than aluminum. Tests also indicate that it is not corroded by salt water and that it does not splinter, tear or "flower out" when pierced by bullets. This plastic has a smooth surface when molded, thus eliminating the necessity of any special finishes and coatings.

Properties exhibited thus far indicate that it may be employed in watercraft and flying-boat hull construction, as well as in many of the secondary and some of the primary aircraft structures.

It is possible to use relatively light equipment in molding this plastic. A pressure of 250 p.s.i. is adequate. Due to this low molding pressure, the customary expensive hardened steel dies are not necessary. Experimental dies have been cast from Kirksite "A" and very good results have been obtained in the molding of all the parts for a complete wing tip assembly from these cheaper dies now used in aluminum fabrication. An additional advantage of the dies is that they may be repeatedly remelted as design changes are made. Figure 2, the Kirksite die for a wing tip skin, illustrates the high polish obtainable on the molding surface.

This wing tip, molded experimentally by a midwestern aircraft company, is composed of only 13 parts as compared to the 96 parts comprising the same wing tip when it is fabricated in aluminum.

Performs are cut to the desired size and shape from the impregnated paper by the use of templates and a sharp knife. This operation is shown in Fig. 5, page 130. The plies of paper are then loaded in the die and molded in the usual manner. The spars and ribs, comprising the internal structure of the wing tip, are molded separately from the skin, in the same manner and of the same material. After all the elements have been separately molded, the entire (*Please turn to page 130*)

1—Finished wing tip made by the laminated paper plastic process. 2—Kirksite die used in molding the skin of the laminated paper plastic wing tip. 3—Laminated paper plastic wing tip under a static load of 2800 lb. This is 140 percent of design breaking load of a comparable aluminum structure. Under this load, wing tip showed slight failures, but wasn't completely destroyed

PHOTOS, COURTESY MANNING, MAXWELL & MOORE, INC.

1

1—Navy gage cases, left to right: original brass case; first non-functional plastic conversion from brass; turret type case of phenolic impact material, now adopted as the Navy standard

Weight saving in pressure gages

FROM the earliest days of the manufacture of pressure gages, the U. S. Navy specifications have always been considered in a plane of their own, well above any other gage specifications. Beginning in 1909, and continuing to the present day, the Navy specifications have kept well ahead of all others.

Until 1929, all Navy gage cases were made from brass, but in that year the Bureau of Steam Engineering, Standards Division (under Commander R. W. Payne), suggested to a large gage company that pressure gage cases be made of phenol condensate in accordance with the then current Navy plastics specifications. The result of this suggestion was that preliminary molds were made, and in 1930 a test was conducted by the Navy. The gage cases which passed this test were approved as a future standard for Navy gages.

The objectives of this change by the Navy were: 1) to get a reduction in the total weight of the gage, 2) to get a gage case with a permenent finsih, 3) to secure a material with good, all-around corrosion and chemical resistance, and the manufacturing advantage of being molded to size without any further machining of the parts.

At this time, no one in Navy engineering or in the engineering department of the gage company conceived the idea of making the case functional, probably because very little functional design was being carried on at that time.

The result was that the metal case was almost copied so far as shape and mechanical structure were concerned. Naturally, in using this phenolic type of plastic material, which inherently had lesser mechanical strength than metal, certain concessions had to be made in general wall thicknesses which were expected to offset this lesser strength. However, the net result was a case with the same general appearance, same type of mounting flanges, and same method of threading the ring to the case as had been used when metal was employed as the material. That is, a design did not evolve which was functionally best for molding from a plastic material. This is clearly apparent in the photographs of the original brass case and the original phenol condensate case (see Fig. 1).

While the original phenolic case was developed for the Navy, it was very quickly adopted by industry and used in all manner of services—oil, chemicals and steam. The reason for this was that the phenol condensate material of that time, fortuitously enough, resisted the action to which it was subjected in many of the uses to which these cases were put. However, over a period of years certain weaknesses were brought out when this casing was called upon to withstand other conditions of use—notably, those aboard Naval vessels.

Many difficulties were encountered by the plastic molders in the molding of this threaded case and ring, and it was found not feasible to mold the threads to such close tolerances as was possible when they were machined from metal. Therefore, the fit between the ring and case was not very close; and

2—Molded parts of first plastic case show threaded construction of bezel and case. Weak section at opening of pipe connection and weak mounting bosses were defects of this plastic conversion. 3—One-piece turret type case has heavy wall section at piping connection, strong mounting lugs. Note absence of threads

2

3

if the parts were not sufficiently cured under exact conditions of mold temperature, they would become still looser and might even, in some instances, permit the rings to fall off the cases. Another difficulty with the original casing was that it did not resist sufficiently the connection-piping strains. This was caused because pipe fitters did not get perfect alignment between the gage connection and the pipe, thus leaving the gage case under permanent stress. Nor could the mounting flanges be strengthened sufficiently because a standard bolt circle diameter had to be used for each nominal size of gage. Therefore, there was some breakage of mounting flanges when the cases were mounted on panels. The feature of the lightness of the phenolic case was of special importance in Naval applications, because of its total weight saving; so it was very important that these objections be overcome.

An attempt was made to eliminate the breakage due to piping strains by employing a flexible connection between the gage connection and the piping. It was sought to improve the fit between the case and ring threads by special attention to the curing of the parts in the molding, and by specially pairing up the cases and rings to ensure the best possible fit. The difficulty with the mounting flange breakage was partially overcome by recommending that resilient bushings be used between mounting flanges and the panel.

The above changes were made in the latter part of 1937, but two years later these major difficulties still occurred too frequently, and it was determined that only a functional redesign of the complete case would eliminate these troubles.

However, certain limiting factors had to be reckoned with in this redesign:

1) Retention of mounting bolt circle diameter and hole size (American Standards Association).

2) Installation by bolts or screws to the wall by means of these bolt holes without disassembling the gage.

3) Use of glass for cover instead of the transparent plastics, all of which at that time supported conbustion and were not sufficiently scratch-resistant.

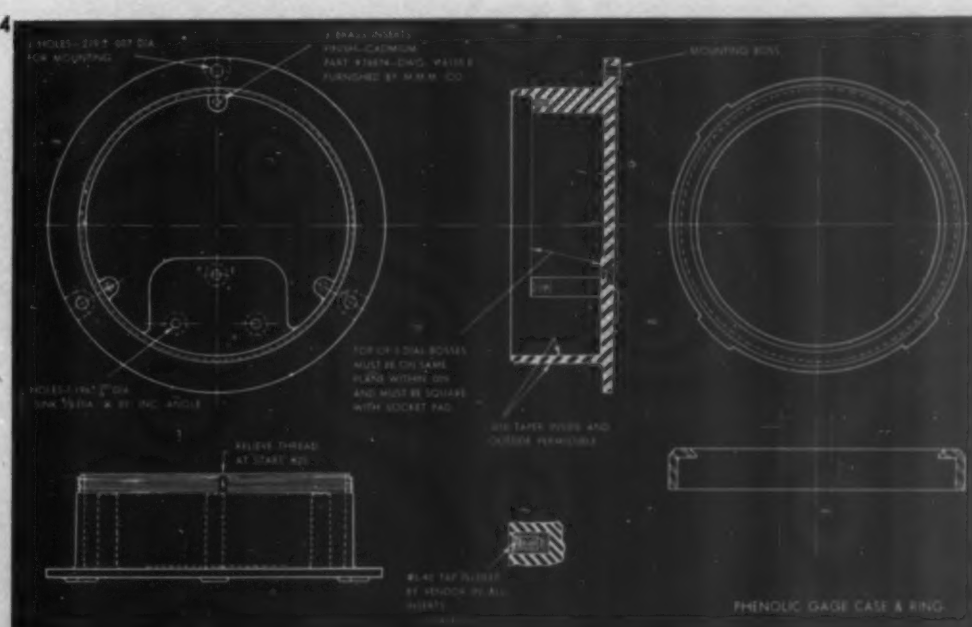
4) Resistance to curve shaped cover.

At this time, the gage company decided that sufficient advance had been made in the art of plastic design to allow the complete case to be made in one piece, eliminating all threads. The Navy Department had contributed a suggestion for overcoming the flange breakage by totally eliminating the mounting flange and using an entirely different means of mounting the gage. A special pocket was to be molded on the back wall of the gage case and a square-headed bolt fitted to it to support the gage.

This, however, would have necessitiated a complete redesign of the mounting flanges for the gages and would not have made possible the substitution of a redesigned case on exactly the same mounting as was standard at that time. It was at that time, and still is, highly desirable to have all cases equipped with a mounting bolt circle diameter of exactly the same dimensions.

It was at this time that the truncated cone shape (see Fig. 3) between the outside edge of the (*Please turn to page 140*)

4



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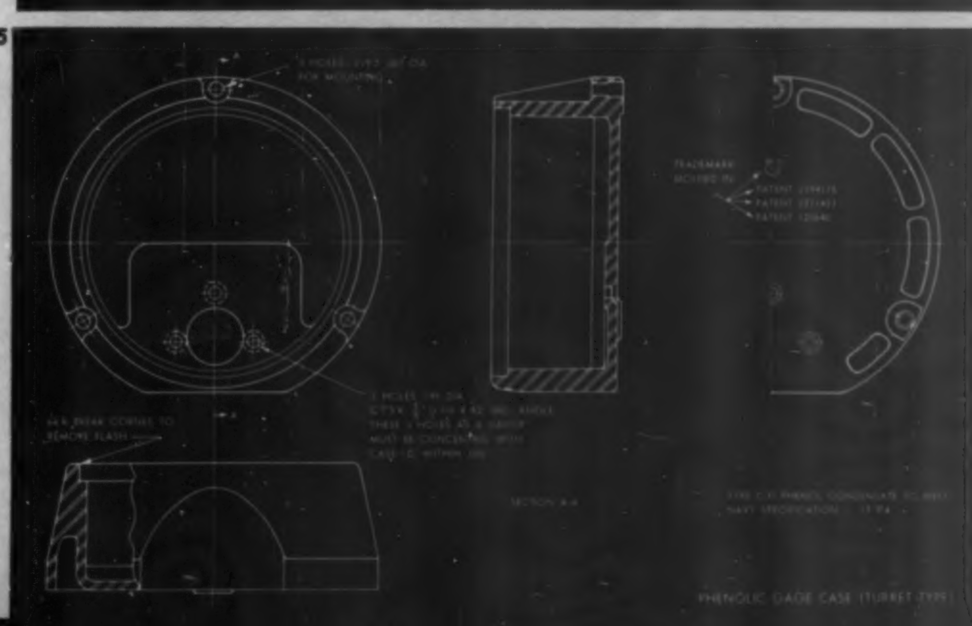


4, 5—Piece drawings showing the original conversion of the case from brass to plastic, and the improved case (below), which is strong yet comparatively light in weight

Forming and repairing acrylic plastics

by D. S. FREDERICK*

IN the manufacture of acrylic plastic sheets, every precaution is taken to prevent the introduction of dirt or other contamination which may affect the clarity of the material. In final inspection, any imperfection in optical qualities is cause for rejection.

In forming the sheets into curved sections,similar precautions must be taken; for in aircraft and in most other applications, acrylic parts must meet close optical as well as high mechanical specifications.

Since they are thermoplastic, acrylic plastic sheets become soft and pliable when heated to 220° F. to 300° F., and can then be bent to almost any shape. When the material cools, it retains the shape to which it is bent, except for a small contraction caused by the lowering of temperature. Formed acrylic sheets, however, have an "elastic" or "plastic memory" and will revert to their original flat shape when reheated to the forming temperature.

Exactly what temperature should be used will depend on a number of factors. On one hand, strains in the formed material can be kept to a minimum by making sure that it is thoroughly heated before forming. Complicated shapes require somewhat higher temperatures than simple curves. On the other hand, when the material is too hot, its surface is too soft and too apt to pick up minor imperfections (called "mark-off") from the form. Fingerprints, glove marks and specks of dirt can make a deep surface impression, requiring extensive polishing later.

Probably the best compromise is to heat the material 15 or 20 minutes, then to allow the surface of the blank to cool a few seconds before letting it come in contact with the form. With experience, the satisfactory degree of pliability can be determined by feeling and twisting the edge of the sheet.

The application of high or even moderately high pressures is neither necessary nor desirable in forming, since it tends to increase the extent of mark-off. The power required to form acrylic plastic sheets is much less than that required for even soft metals. Heated acrylics can be handled like a sheet of pure gum rubber and approximately the same force is required to stretch it. For simple, two-dimensional shapes, especially with thick material, the weight of the material is usually sufficient, and only if considerable stretching is involved should much pressure be applied.

Contour tolerances of $\pm$ .125 in. can be maintained in most forming operations, but for three-dimensional sections with a deep draw, greater latitudes should be allowed.

Heating the material

Ovens heated by steam, electricity or gas have been found most satisfactory. To keep the temperature within the 220°–300° F. range, it is especially desirable to install adequate control equipment and to circulate the hot air inside the oven. The acrylic sheets may be hung vertically in the oven or placed on trays with cloth bottoms.

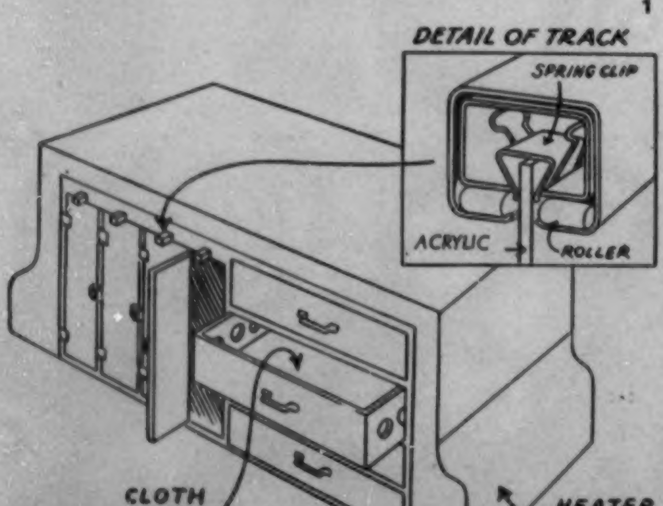
Remove masking paper before heating the sheets for forming. If necessary, if the sheets are dirty or dusty, rinse with distilled water, or if tap water is used, dry the material thoroughly by blotting with soft tissue paper. Any solids in ordinary tap water will bake into the surface if this precaution is not taken.

While hot air ovens are most satisfactory because they are clean and can accommodate a variety of sheet sizes, there are other means of heating acrylics. Boiling water is not satisfactory, except for very thin material, for two reasons: first, it is not really hot enough and the addition of salt or glycerine to the water does not raise the temperature sufficiently. Second, unless wiped off carefully, water may be trapped between the sheet and the form. If this water should

* Sales manager, Plastics Division, Rohm & Haas Co.

1—To heat acrylic sheets for forming, hang vertically in ovens, or place in drawers with cloth bottoms. 2—Taped, cracked acrylic section may be used as a mold when damaged parts must be replaced in the field

1



ALL PHOTOS, COURTESY ROHM & HAAS CO.

2

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6

5—To form a bomber nose section, workmen drape the hot acrylic sheet over the form. 6—Wooden carpenters' clamps spaced around the form hold sheet in place until it has cooled, when it will retain shape of the form

vaporize, it may cause cloudy "steam spots" on the material.

Hot oil baths are more satisfactory and relatively easy to set up. Their temperatures are high enough and can be kept fairly constant. If the oil is clean, it does not affect the surface. Oil, however, makes the material difficult to handle and adequate provision must be made for the inevitable dripping and splashing.

Forms for acrylics

Since most forms for acrylics are subjected to no great pressure, they may be made of material as brittle as plaster. The choice between plaster, wood, metal, masonite and combinations of materials, therefore, depends on considerations of cost and length of expected service. For simple two-dimensional bends, metal, masonite or plywood forms are easily made; for more complicated shapes, plaster forms are easier to make and perfectly satisfactory. It is usually advisable to reinforce the plaster with wire and to use strips of metal at the edges, especially for stretch forming where there may be considerable pressure on the edges.

The form should be provided with a base or some other means to hold it at a comfortable working level. It should also be somewhat larger than the finished piece. This precaution permits the use of slightly oversize sheets, which simplifies handling and compensates for the slight tendency of the hot sheet to curl away from the form at the edges. This slight flaring is due to the fact that the outer surface cools sooner than the surface in contact with the form. It is helpful to mark a "trim line" on the form, indicating the limits of the finished piece.

The form should be free of waves and other variations in contour which might cause optical distortions. The surface

3—Second step in emergency field forming: cracked section is held in wooden supporting structure, filled with plaster of Paris. 4—Rigid hold-down ring, or yoke, reduces man-power required for forming acrylics

3

4

should be sanded smooth and covered with soft cloth (such as billiard table felt, outing flannel or imitation chamois) or flocked rubber or suede rubber sheeting. The forms should be kept clean and brushed off before each piece is formed.

Forms should also be stored carefully when not in use to avoid denting, chipping or warping, as such defects may show up in the acrylic material when forming is resumed.

Emergency field forms

In the field, where no forms are available to make replacements for damaged sections, it is possible to use the damaged section itself as a mold to construct the form. In the case of a badly cracked section, the crack is first drawn together by taping both surfaces. A wooden supporting structure is then made which exactly fits the outside contour of the damaged section. The damaged section is placed in the supporting structure, and after greasing this acrylic mold, it is filled with plaster of Paris. After the plaster sets, it is removed from the mold, and carefully sanded to remove all imperfections including the mark left by the crack. It is now covered with soft cloth, and the result is a form similar to the one on which the original section was shaped.

Simple forming

The heated sheet is handled with soft cotton gloves to avoid fingerprinting the surface. If possible, do not touch the material inside the trim line. The surface is allowed to cool slightly by waving the sheet in the air a few seconds. Then it is laid across the cool, clean form.

While the material is cooling, it may be necessary to rub the edges to reduce the tendency of these edges to curl away from the form. For long pieces, a strip of wood covered with cloth may be necessary to hold the edges against the form. Rubber bands may also be used to hold it in place.

In many cases, pieces can be best formed by using a hold-down ring or yoke, fitted to the mold but allowing for the thickness of the material between the mold and the ring. This ring should be hinged or otherwise attached to the form so that it will fit exactly when pressed down on the hot sheet. Stops should be arranged to prevent the ring from being forced into the soft, hot plastic when pressure is applied.

This hold-down ring may be the exact size and contour of the piece, so that when the material has cooled the piece may be scribed, on the form, around the inside of the ring. The section should not be scribed until it has cooled, however, since its contraction on cooling may be larger than the allowed tolerances. The use of a hold-down ring prevents the material from curling away from the form and also permits the use of smaller blanks to obtain the same size finished piece.

Be sure the section is thoroughly cool before removing it from the form. The material will tend to resume its original

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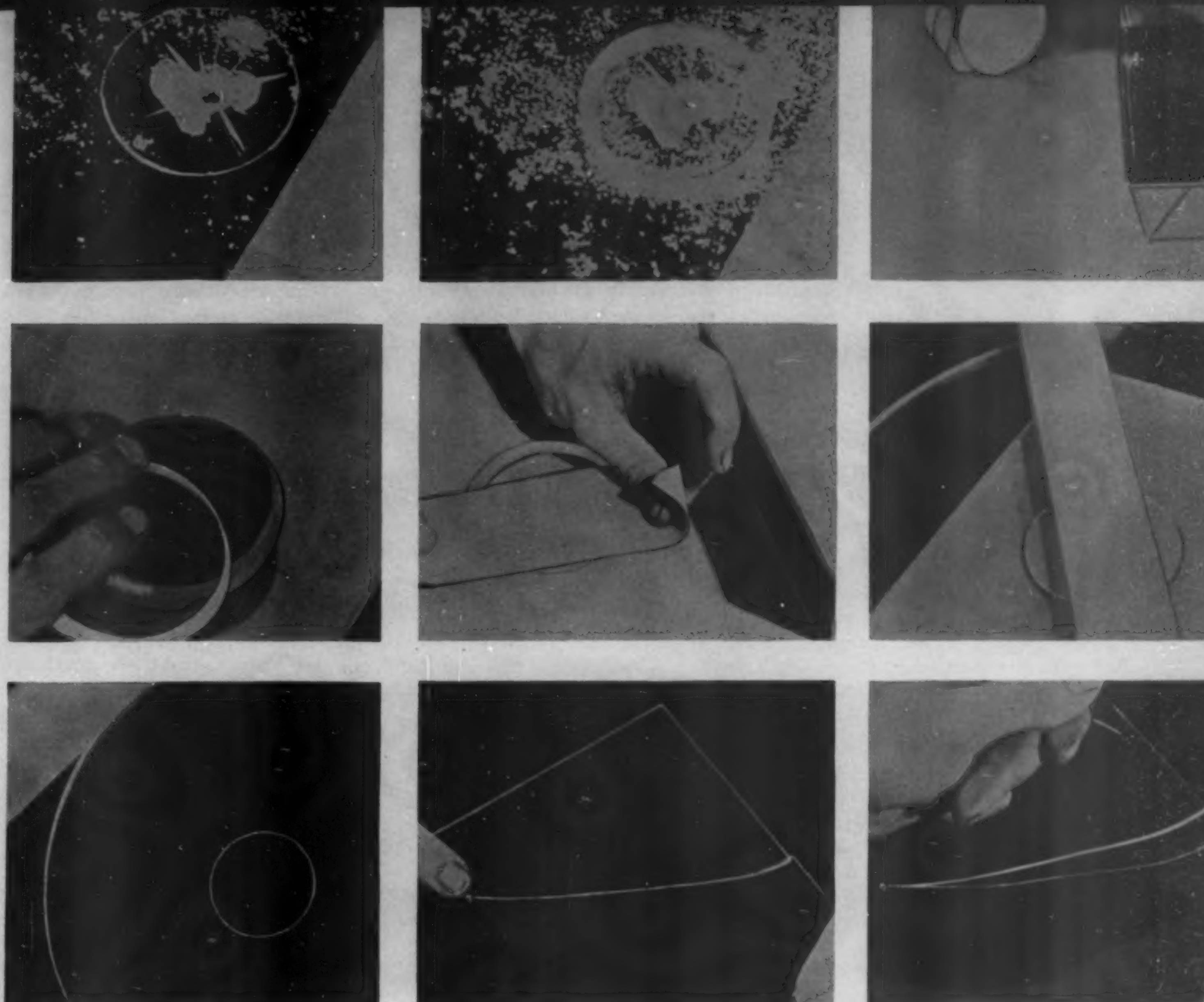
7


8

7—*Polishing with a soft, dry cloth brings aircraft sections to a high gloss. Free, circular motion will prevent overheating of the sheet.* 8—*Typical bullet hole in acrylic bomber section, with its rosette of radial cracks, looks like an exotic tropical flower.* 9—*Diagram shows method of repairing cracks in acrylic*

9



10

10—*To repair bullet hole in acrylic section, a circle is trimmed around hole and radial cracks, and a patch cut to size, taped into position until it cools; then removed, soaked in cement, returned to position, where it is held until it hardens. Filing, sanding and buffing will clean up the patch and the surrounding areas*

flat shape unless it is well below its softening point when taken from the form.

If reasonable care has been exercised, there will be no form marks or mark-off on the surface. If there is, put the sheet back in the oven. It will resume its flat shape—and its original surface except for scratches—and can then be formed again. It is more economical to re-form several times, than to sand and buff out mark-off. The latter procedure can be followed, of course, if mark-off cannot be eliminated even after successive re-forming.

Stretch forming

Many three-dimensional shapes can be made by literally stretching the acrylic sheet across a form. The material is heated slightly hotter than for simpler forming, but the surface allowed to cool slightly, as usual. During the cooling, a number of wooden carpenters' clamps are fastened to the edges, six to ten inches apart.

Holding the edges of the sheet in these clamps, a circle of men draw it down around the form. A metal ring as described above can be clamped in position around the edges, leaving the crew free to work on another form.

Since five to ten men may be required for this stretching—depending on the size and thickness of the piece and the extent of the stretch—the form must be well-built and firmly mounted.

On slight three-dimensional forms, a rigid yoke may be used to stretch the material and to hold it in place. This device may cut down on the man-power required.

Male and female forming

For three-dimensional sections, especially sections of irregular contour, male and female forms may be used, but the method cannot be recommended. The hot sheet is stretched across the top of one form, usually the female, and held in position by hand or with clamps while the other form is lowered into place. In this method, a long cooling time is required because the material is clamped between two forms and its heat does not dissipate quickly.

The basic objection to this type of forming lies in the fact that both sides of the acrylic sheet come in contact with mold surfaces and both are therefore subject to mark-off. This mark-off is quite severe and may require extensive sanding and polishing—more expensive operations in themselves than the other and better forming methods.

Mechanical or hydraulic presses (*Please turn to page 138*)

Stock molds

SHEET ONE HUNDRED TWENTY-SIX

Control and ball knobs for use in airplane equipment, box for razor or other items, outlet box for switches, and wing nut are available from stock without mold cost, provided that restrictions on supplies of raw materials, etc., have not limited current production. Write Stock Mold Dept., Modern Plastics, Chanin Bldg., New York, giving item and sheet numbers

---

1467. Box with hinged cover, 6 1/2 in. long, 3 1/8 in. wide, 1 7/8 in. high. Legs at 4 corners 1/8 in. high. Black base with red cover

1468. Outlet box for switches, 3 3/8 in. long at base, 2 1/8 in. wide, 2 1/4 in. high. Five grooves on one side

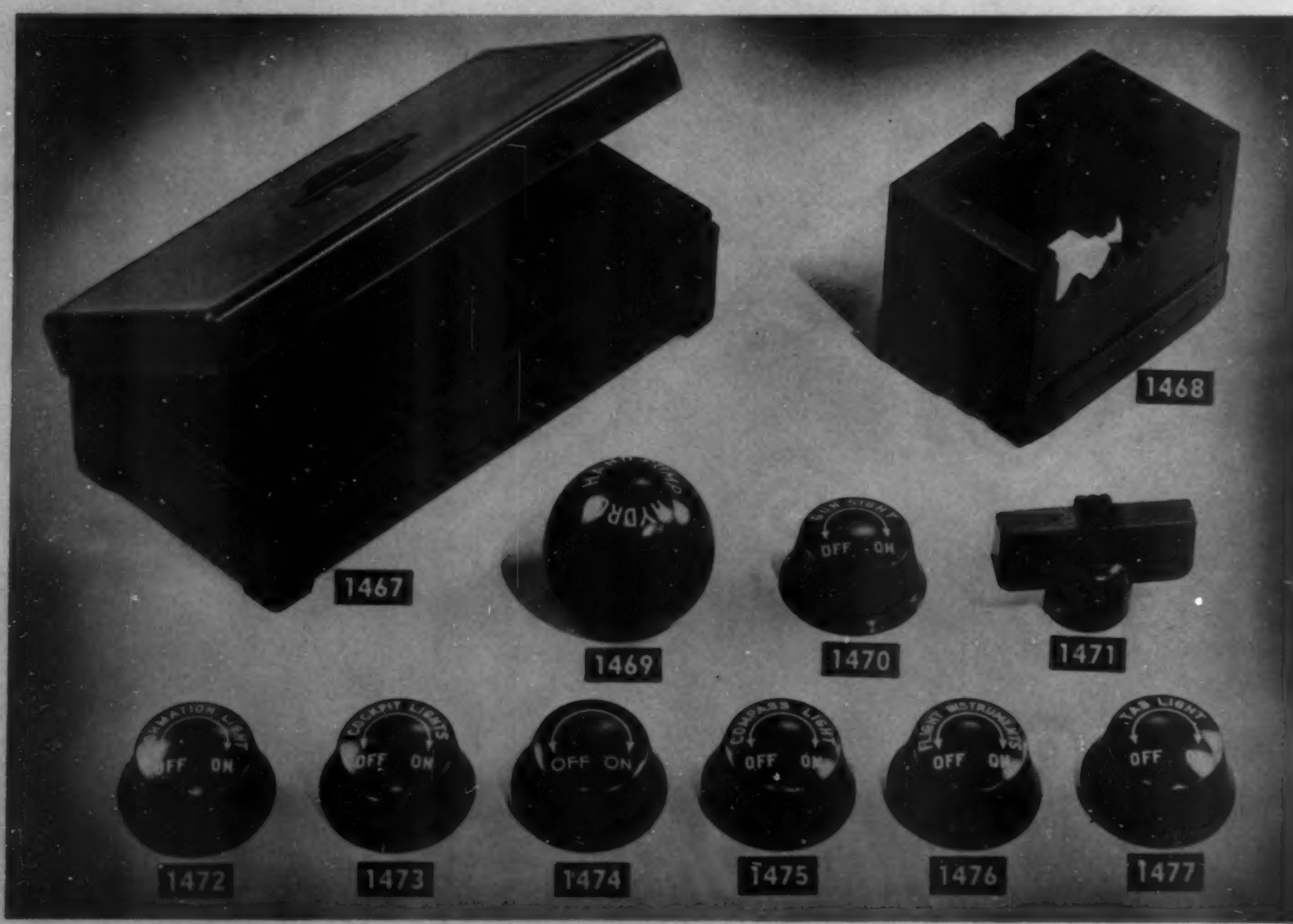
1469. Hydraulic hand pump ball knob 1 3/4 in. diameter. 3/4 in. threaded opening

1470. Control knob, 1 1/2 in. diameter, 3/4 in. high, 5/8 in. center opening depth. Equipped for installation on standard instruments utilized by airplane manufacturers. Available with or without brass inserts, with or without set screws, with or without screw threads. Lettering (Gun sight—off, on) can be wiped in with ordinary filler or with luminescent filler

1471. Wing nut, 2 in. long at top, 7/8 in. diameter at base. Center opening throughout 3/8 in. Threaded metal insert

1472–7. Control knobs same as 1470, marked for following purposes: Formation light—off, on; Cockpit lights—off, on; Off, on; Compass light—off, on; Flight instruments—off, on; Tab light—off, on

Reprints of all stock mold pages which have been published to date, with complete index of suppliers, are available to Stock Mold Service subscribers



Acid and alkali resistance of plastics*

by JOHN DELMONTE[1]

MANY qualitative data have been published upon the resistance of plastics to chemicals, in particular acids and alkalies. These experiments have been valuable in that they reveal those materials which are quite active in attacking plastic materials. A very complete report on the effect of chemicals was published in 1941.[2] Utilizing the A.S.T.M. Tentative Method of Test for Resistance of Plastics to Chemical Reagents (D543-39T)[3] the investigators reported upon numerous plastics which were immersed in various acids, alkalies and solvents. The effects were noted as percentage changes in weight and dimension for a 7-day immersion period at 25° C. Further interesting data were revealed upon subsequent exposure to air at 77° F. and 50 percent relative humidity.

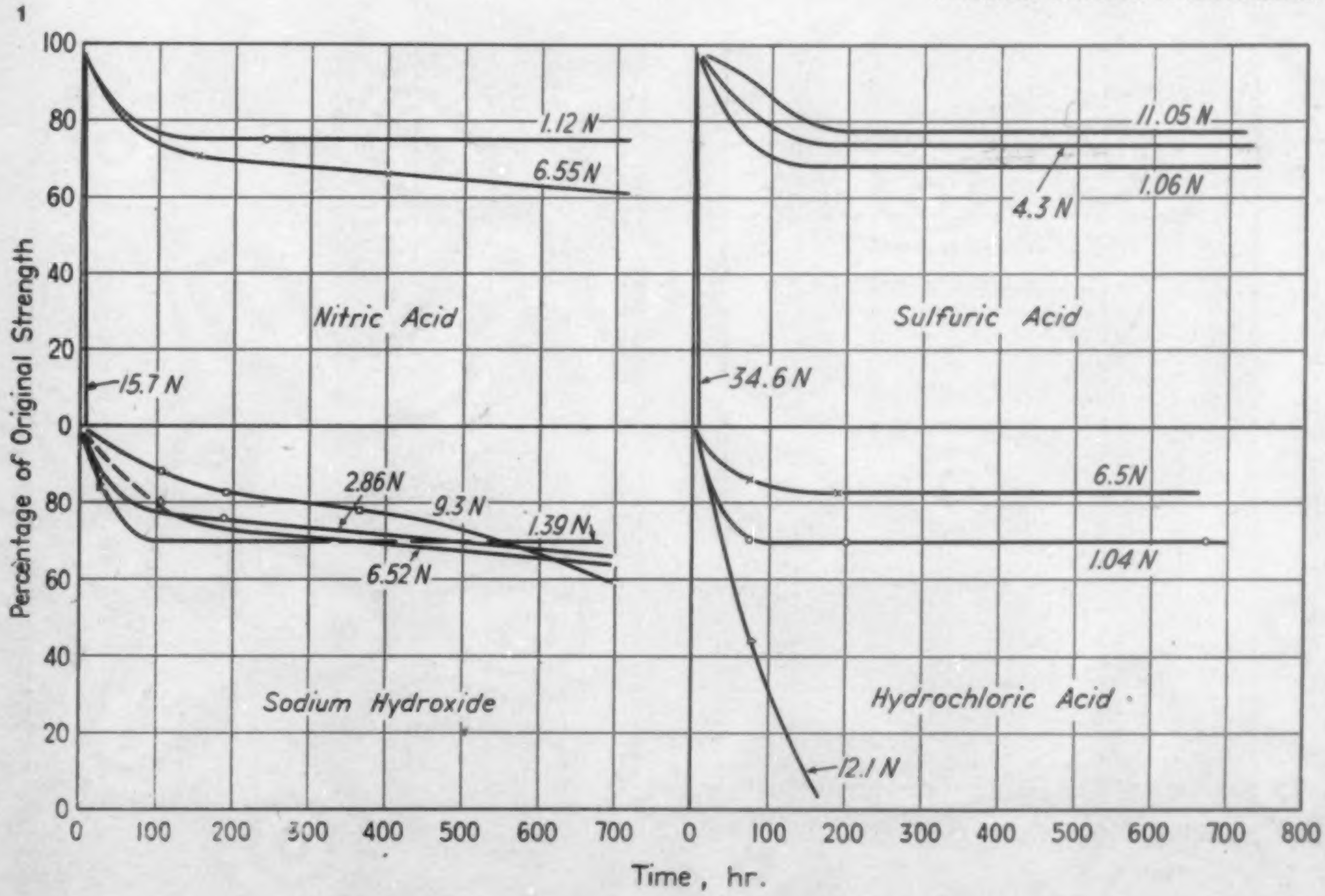
In the current investigation a wide range of acid and alkali concentrations were employed, and a quantitative examination made of the effect upon plastic materials at various intervals. It was reasoned that if the acid or alkali attacked the plastic material, such an attack would be observed by a decrease in the physical properties of the material. This method of analysis, whereby the progress of chemical attack is noted by changes in the physical properties, is not new, having been employed in other investigations.[4,5,6]

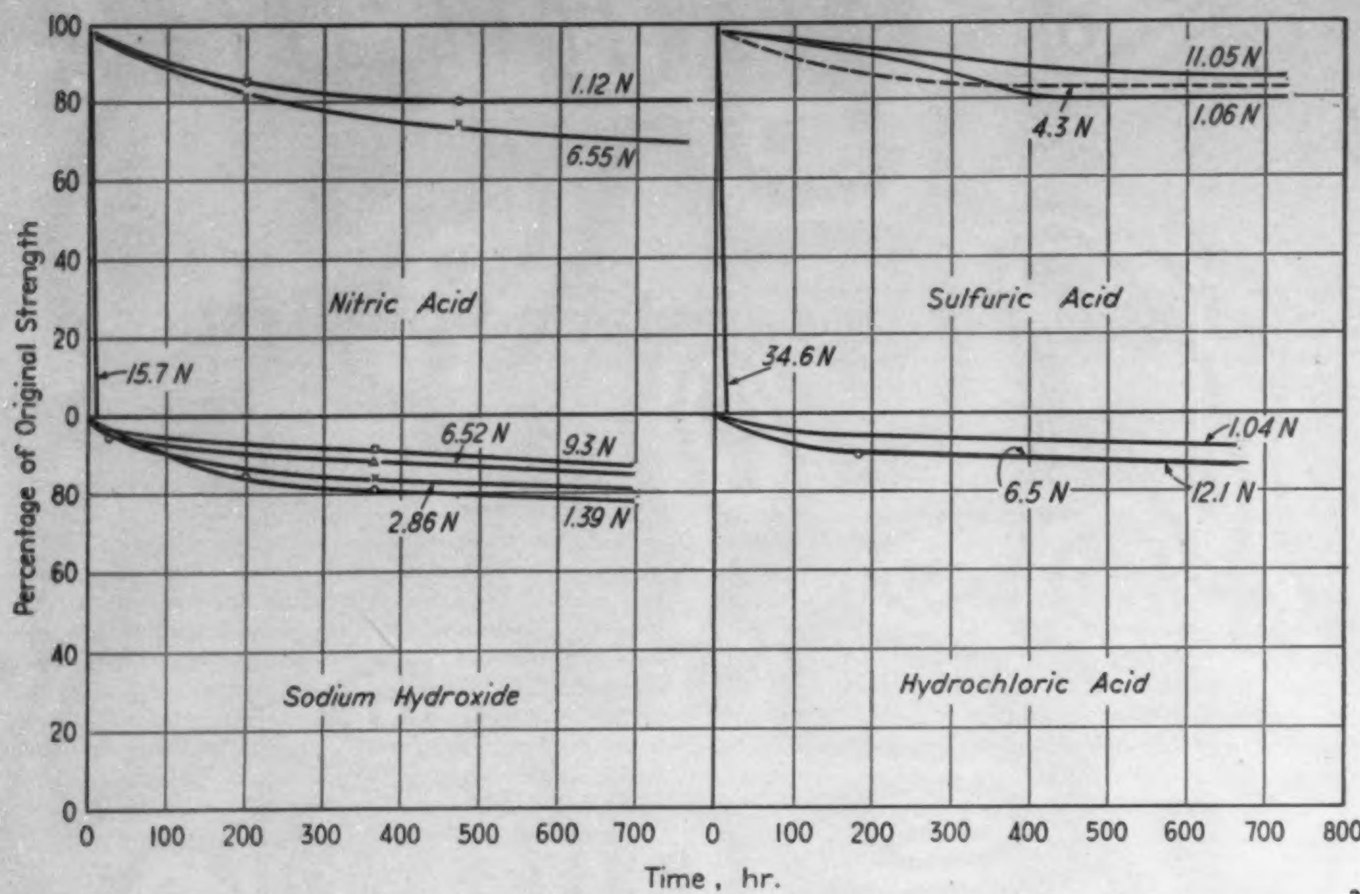
It was felt that such tests should be performed at fairly frequent intervals during the first few hours of immersion

* This paper was presented at the Annual Meeting of the American Society for Testing Materials in Atlantic City, N. J., on June 23, 1942, and is published here by permission of that Society.
[1] Technical Director, Plastics Industries Technical Institute.
[2] G. M. Kline, R. C. Rinker and H. F. Meindl, "Resistance of Plastics to Chemical Reagents," *Proceedings Am. Soc. Testing Mats.*, Vol. 41, p. 1246 (1941); MODERN PLASTICS, *19*, 59 (December 1941).
[3] 1939 Book of A.S.T.M. Standards, Part III, p. 805.
[4] Sakurada-Watanabe, *J. Soc. Chemical Industry* (Japan), Vol. 39, Supplement 50, p. 1 (1936).
[5] S. Peierls, "Polyvinyl Alcohol Plastics," MODERN PLASTICS, *18*, 53 (Feburary 1941).
[6] John Delmonte, "Effect of Solvents on Organic Plastics," *Industrial and Engineering Chemistry*, Vol. 34, 764 (June 1942).

1—*Results of test on cellulose nitrate*

1





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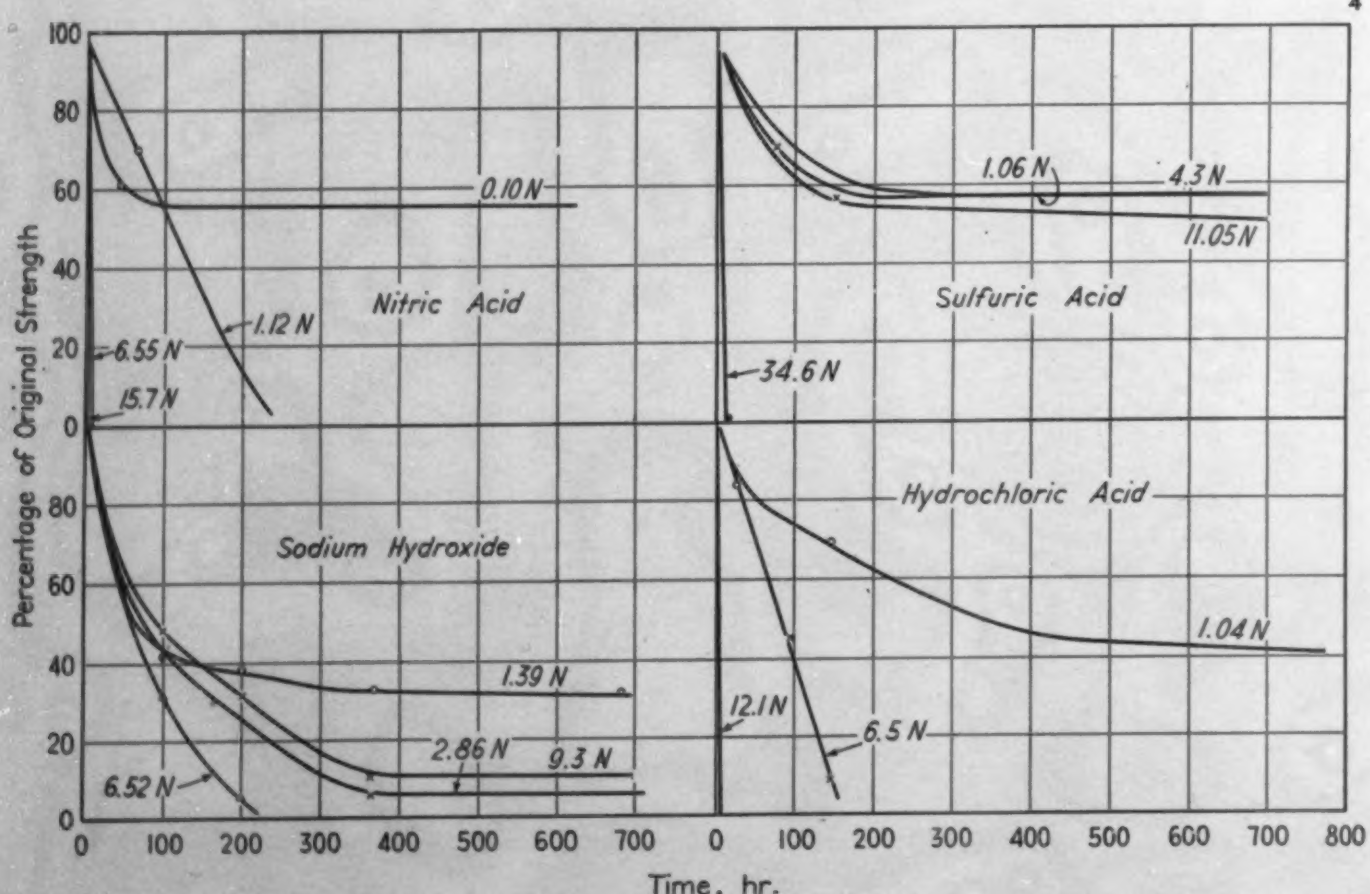
2—Results of test on polymethyl methacrylate. 3—Results of test on cellulose acetate

4



and then every other day or so once the tests were under way. The punch-and-die method of test[7] was employed, as this technique not only allowed a test to be performed within the space of a few seconds but also required only a small test specimen. Thus, for example, samples of plastic material $1/2$ in. wide, $2\,1/2$ in. long and about $1/16$ in. thick were employed. The punch was 0.104 in. in diameter and the die about 0.108 in. in diameter to avoid excessive stress concentrations at edges of the punch. Loads were measured with an arbor press and spring-loaded scale. The specimens were placed in the center of the punch and the lever arm pulled down by hand until failure was observed. Punch strength was calculated from the following formula:

$$S = \frac{P}{\pi \times 0.104 \times t}$$

where

S = punch strength in pounds per square inch
P = load in pounds to produce failure
t = thickness in inches

However, the chief concern was *the change* which took place in the plastic after various immersion periods in the corrosive chemicals, rather than absolute values, and data are reported as percentage changes from the original physical condition. Thus, when a plastic was completely disintegrated by the acid or alkali the percentage change would be 100 percent.

Based upon calibration tests on the load-measuring device, commercial variations in the thickness of test samples, and the ability to reproduce results, the accuracy of the readings may be taken as ±5 percent. The large number of readings taken in each test, however, permitted a representative curve to be plotted.

[7] John Delmonte, "Shear Strength of Molded Plastic Materials," *ASTM Bulletin*, No. 114, January 1942, p. 25; MODERN PLASTICS, *19*, 63 (September 1941).

Materials tested

Included in this investigation were the following plastic materials:

1. Laminated phenolic plastic, paper base, grade XX, $1/16$ in. thick.
2. Cellulose nitrate, Celanese Celluloid Corp., 0.045 in. thick, black.
3. Cellulose acetate, Monsanto Chemical Co., $1/16$ in. thick, clear.
4. Polyvinyl chloride acetate, Carbide and Carbon Chemicals Corp., $1/16$ in. thick, cream color.
5. Polystyrene, A-200, Monsanto Chemical Co., $1/16$ in. thick.
6. Polymethyl methacrylate, Rohm & Haas Co., $1/16$ in. thick, clear.
7. Laminated phenolic, glass base, 0.055 in. thick.

The last sample was employed only in part of the tests, where it was necessary to determine whether the chemical attack was directed against the paper base or against the phenolic resin binder of material No. 1.

Acids selected for these tests were chemically pure nitric acid, sulfuric acid and hydrochloric acid. Sodium hydroxide was employed as a representative alkali. Solutions of various normalities were prepared and their strength carefully checked by titrations against 0.1 N standard hydrochloric acid and 0.1 N standard sodium hydroxide solutions. Test specimens were placed in small corked 3-dram vials, which were filled with the acid or alkali being used. Since it was

4—Results of test on laminated phenolic paper base

4

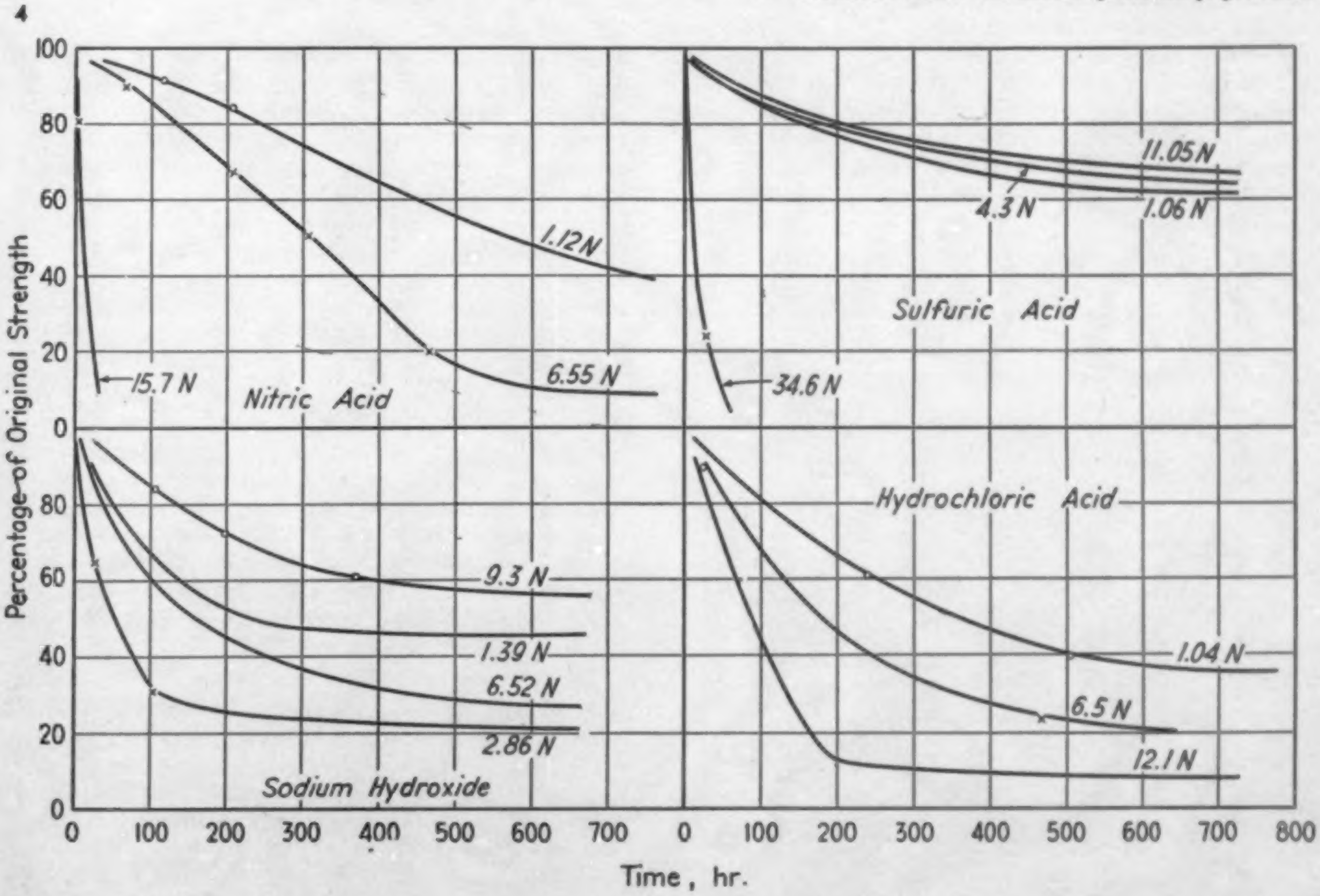


Table I.—Effect of 700-Hours' Immersion in Acids and Alkalies on Polystyrene and Polyvinyl Chloride Acetate

	Polystyrene	*Polyvinyl chloride acetate*
1.39 *N* sodium hydroxide	88 percent of original strength	90 percent of original strength
2.86, 6.52 and 9.3 *N* sodium hydroxide	Unaffected	Unaffected
34.6 *N* sulfuric acid	80 percent of original strength	54 percent of original strength
1.06, 4.3 and 11.05 *N* sulfuric acid	Unaffected	Unaffected
15.7 *N* nitric acid	84 percent of original strength	Unaffected
1.12 and 6.55 *N* nitric acid	Unaffected	Unaffected
1.04, 6.5 and 12.1 *N* hydrochloric acid	Unaffected	Unaffected

determined that conditioning influenced results, all specimens were placed in a drying oven at 50° C. for at least 48 hr. prior to test.

Test results

The results of these tests are shown in Figs. 1 to 4 and in some of the accompanying tabular data. First, referring to the illustrations, it will be noted that the ordinates represent percentage of original strength. It is more convenient to plot the data this way than to refer to an absolute unit such as shear strength. The tests determined the change from the original strength of the plastic, since this factor serves as a clue to the effect of penetration by the acid or the alkali. By reducing all quantities to the percentage variation one material may readily be compared with another.

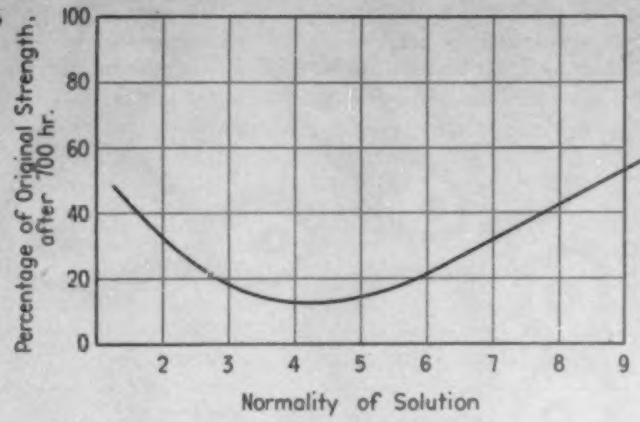
Polystyrene and polyvinyl chloride acetate were tested in identical manner to those materials shown in Figs. 1 to 4, but the results are not reported in graphical form. These materials were practically unaffected by all the acid and alkali concentrations employed over the entire test period, which was close to 800 hours. The data for these materials are shown in Table I.

From the foregoing it is apparent that polystyrene and polyvinyl chloride acetate are definitely superior in acid and alkali resistance to the cellulose acetate, cellulose nitrate, laminated phenolic paper and polymethyl methacrylate materials referred to in Figs. 1 to 4. As to choosing between polystyrene and the polyvinyl copolymer, it is rather difficult to arrive at a decision. Polystyrene is more resistant to strong concentrations of sulfuric acid while polyvinyl chloride acetate is less affected by strong concentrations of nitric acid. However, in either case these materials are very much more resistant to strong concentrations of acids than the other plastics tested, which in a matter of several hours were entirely decomposed.

The mode of decomposition varied somewhat. Some materials, like cellulose acetate, whitened on the surface and then eventually reduced to a shapeless mass of material. Others such as the laminated phenolic tended to delaminate in nitric acid and swell in the presence of sodium hydroxide; on the other hand, there was a visible decrease of dimensions in hydrochloric acid. When the change in the thickness of the test specimen was appreciable, a correction was made in calculating the change in punch strength as estimated in the formula indicated earlier in this paper.

Effect of conditioning: The effect that previous conditioning of test specimens had upon the results is shown in Fig. 5, which demonstrates the loss in strength in cellulose acetate, not only as a function of time but also of moisture content. Specimens that previously had been conditioned in dry, 30 percent and 75 percent relative humidity atmospheres and in water, respectively, for several days prior to test, were placed in strong sodium (*Please turn to page 146*)

6



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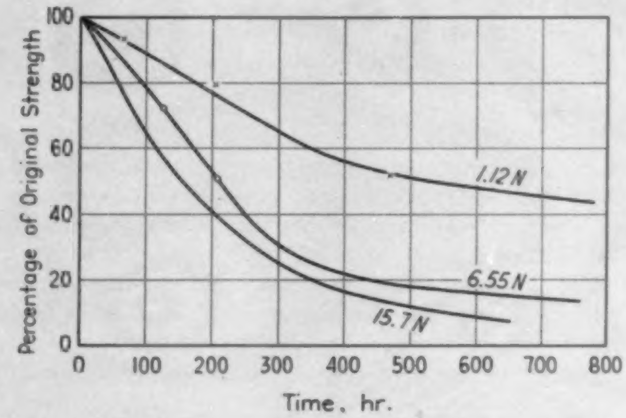
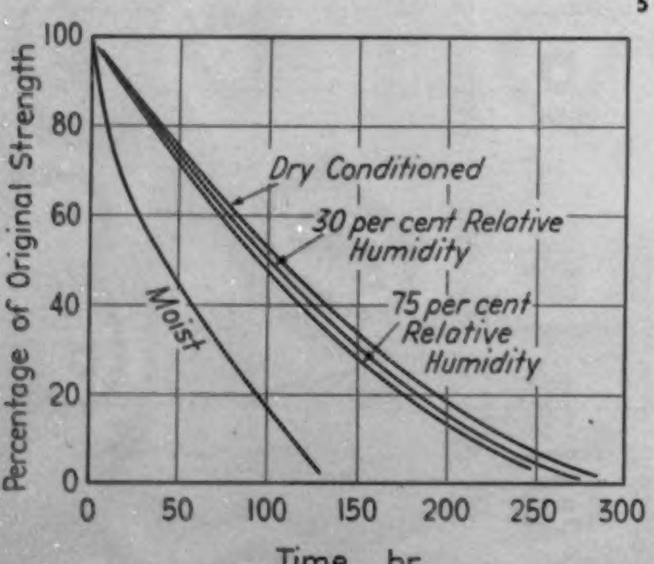


6—Effect of NaOH on laminated phenolic paper base. 7—Effect of HNO_3 on laminated phenolic woven glass base

5—Effect of 4.4 N NaOH on a cellulose acetate

5



Repeated flexural stress (fatigue) test[1]

Scope

1. This method covers the test procedure for determining the effect of repetitions of stress on plastics by a fixed-cantilever type of testing machine designed to produce the same maximum deflection of the specimen in each cycle (Note). This test is also applicable to plastic impregnated wood and plastic bonded plywood.

NOTE. Since the characteristics which render a material resistant to fatigue are not completely known, and since the effect of such factors as the variations in shape of specimen, type of testing machine and conditions of test (speed of machine, temperature of specimen, atmospheric temperature and relative humidity) are not completely known, the details considered in this method concern those factors known to have important influences. Since other factors equally as important may in the future be discovered, the details of the recommended practice are largely advisory in nature.

Definitions

2. (*a*) *Fatigue* (*progressive fracture*). The phenomenon of the progressive fracture of a material by means of a crack which begins and spreads under the action of repeated cycles of stress.

(*b*) *Fatigue strength* (S_F). The maximum amplitude of an alternating stress cycle, expressed in pounds per square inch, which will not cause fracture of the material for a given number of cycles of alternating stress. The corresponding number of cycles of stress must be stated (Note). If the term is used without further qualification, it is understood that the stress cycle is such as to produce a complete reversal of stress (from tension to compression), see Fig 1 (*a*). When the stress cycle does not produce complete reversal of stress, the mean stress of the cycle must also be stated. (In this case the fatigue strength is not the maximum stress in the cycle, Fig. 1 (*b*), (*c*), (*d*).)

NOTE. For some plastics and some metals the fatigue strength remains constant beyond a certain number of cycles of stress. That is, below a certain value of alternating stress the material does not fracture for an indefinitely large number of cycles of stress. The corresponding value of fatigue strength is commonly known as the endurance limit.

Unfortunately, in the literature on fatigue of metals the terms endurance limit, endurance strength and fatigue limit have been used interchangeably. They have been used to refer to the *maximum stress* in a stress cycle below which no evidence of fracture can be detected after a very large number of cycles of loading. The same terms have also been used to refer to the maximum stress in a stress cycle which would cause fracture after an arbitrarily selected number of cycles. This definition has been used in tests of metals for applications in which the number of repetitions of maximum loading in the life of the structure was expected to be relatively small.

(*c*) *Mean stress* (S_M). The algebraic mean between the maximum and minimum stress produced in a material during an alternating cycle of stress. When used in conjunction with the fatigue strength the term mean stress denotes the mean stress for which the stated fatigue strength was determined. The sign of the mean stress, whether tension (+) or compression (−), must be stated. The mean stress is used together with the fatigue strength to define the range of variation of stress in the stress cycle for which the fatigue strength was determined. The mean stress of a cycle is important because in general the fatigue strength of a given material will depend upon the magnitude of the mean stress. Thus it is necessary to specify both the fatigue strength and the mean stress.

In Fig. 1 stress versus time curves are shown for one cycle of stress with different combinations of mean stress S_M and superimposed alternating stress. The alternating stress cycle shown has an amplitude equal to the fatigue strength S_F.

In Fig. 1 (*a*) the fatigue strength is S_F, the mean stress is zero, and the maximum tension equals the maximum compression.

In Fig. 1 (*b*), (*c*), (*d*) the mean stress S_M is not zero. In Fig. 1 (*b*) the cycle of stress produces a maximum tension greater than the maximum compression. In Fig. 1 (*c*) all values of stress in the cycle are tension. In Fig. 1 (*d*) all values of stress in the cycle are compression.

NOTE. Another way of defining the range of variation of stress in a stress cycle is to use the "range ratio." The range ratio has been defined as the ratio of the (numerical) minimum stress to the maximum for any cycle. Thus the range ratio and the fatigue strength must be stated to define the range of variation of stress in the stress cycle for which the fatigue strength was determined.[2]

(*d*) *Fatigue ratio*. The ratio of fatigue strength for cycles of completely reversed stress to the static tensile strength of the material as determined in accordance with the Tentative Methods of Tension Testing of Plastics (A. S. T. M. Designation: D 638) of the American Society for Testing Materials.[3]

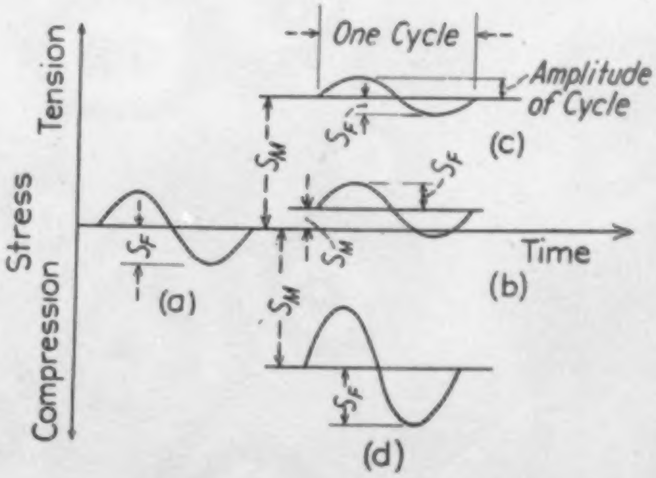
[1] This tentative method for Repeated Flexural Stress (Fatigue) Test of Plastics, A.S.T.M. Designation D671-42T, is published here by permission of the American Society for Testing Materials.

[2] See "Present-Day Experimental Knowledge and Theories of Fatigue Phenomena in Metals," Appendix to the Report of Research Committee on Fatigue of Metals, *Proceedings*, Am. Soc. Testing Mats. *30*, Part I, 260 (1930).

[3] 1942 Book of A.S.T.M. Standards, Part III.

1—*Stress-time, different ranges of variations of stress*

1



Apparatus

3. The apparatus (Fig. 2) shall consist of the following:

(*a*) *Testing machine.* A fatigue testing machine of the fixed-cantilever, repeated constant-deflection type (see Appendix I). In this machine the specimen, *A*, Fig. 2, shall be held as a cantilever beam in a vise, *B*, at one end, *M*, and bent by a concentrated load applied to a holder, *J*, fastened to the other end. The bending shall be accomplished by a connecting rod, *C*, driven by a variable eccentric, *D*, mounted on a shaft. The shaft shall be rotated at constant speed by a motor. The vise may be set in the plane of the eccentric so that the beam will be deflected the same amount on either side of the neutral position (completely reversed stress) or the vise may be set so that the deflection is greater on one side than on the other (mean stress not zero).

(*b*) *Counter.* A counter, *K*, Fig. 2, geared to the shaft so as to record the number of cycles. A suitable mechanically or electrically operated cut-off switch, *L*, shall be provided to stop the machine when the specimen fractures.

(*c*) *Holder.* A holder, *J*, Fig. 2, for the test specimen proportioned in such a way as to place the center of percussion of the oscillating portion of the specimen and holder at the wrist pin, *F*. It shall have as little mass and as large rigidity as possible in order to minimize inertia effects. A diagram of the holder for the free end of the specimen is shown in Fig. 3. It is necessary, for some materials, to use rubber gaskets in the grips on both the holder and the dynamometer to prevent failure at the grip due to stress concentration and chafing.

(*d*) *Dynamometer.* The vise, *B*, Fig. 2, containing a dynamometer (Note) for measuring the load on the specimen. The dynamometer shall consist of a reduced section, *G*, which acts as a spring, and a dial gage, *H*, to measure the deflection of the spring when the specimen is deflected.

NOTE. Another form of this machine does not contain a separate dynamometer but uses the specimen as a dynamometer. In this case a dial is used to measure the deflection of the specimen under a known load, preferably the load which is repeatedly applied to the specimen. This requires a separate calibration for each specimen. The result obtained is very nearly identical to that obtained with a dynamometer.

Test specimens

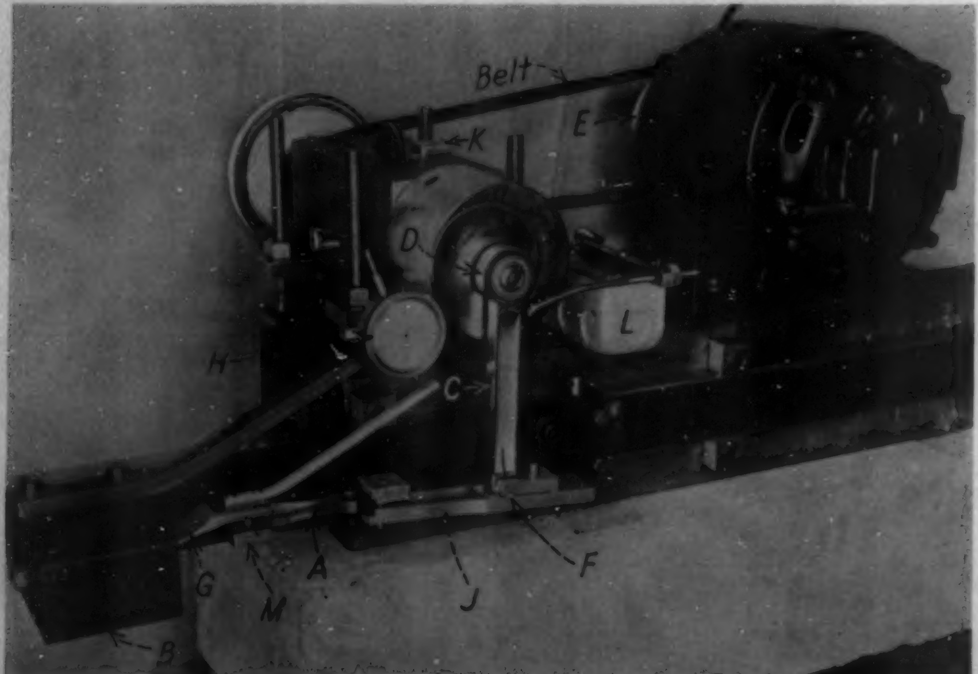
4. (*a*) *Unnotched specimen.* The unnotched specimen shall conform to the dimensions shown in Fig. 4 (*a*). The cross section at the center of the specimen shall be 0.3 in. square, except in the case of the specimen from thin sheet[4] which shall be 0.3 in. by the thickness of the sheet. The 2-in. radius (Note) of the scalloped sides shall be formed by milling, using a very sharp cutter and such combination of speed and feed as will give a good finish with a minimum of heating of the specimen. The test specimen shall be polished with successively finer emery paper, finishing with No. 00 to remove all scratches and tool marks. The final polishing shall be lengthwise of the specimen, since even small scratches transverse to the direction of tensile stress tend to lower the fatigue strength. In order to avoid heating, all polishing shall be done either by hand or with light pressure on a slowly revolving sanding drum. Care shall be taken to avoid rounding the corners.

NOTE. With a cantilever specimen the maximum stress does not occur exactly at the minimum section, but slightly farther from the point of loading, *F*, Fig. 2. However, with a moment arm of 5 in. and a specimen with a radius of 2 in. this discrepancy is small enough to be neglected.

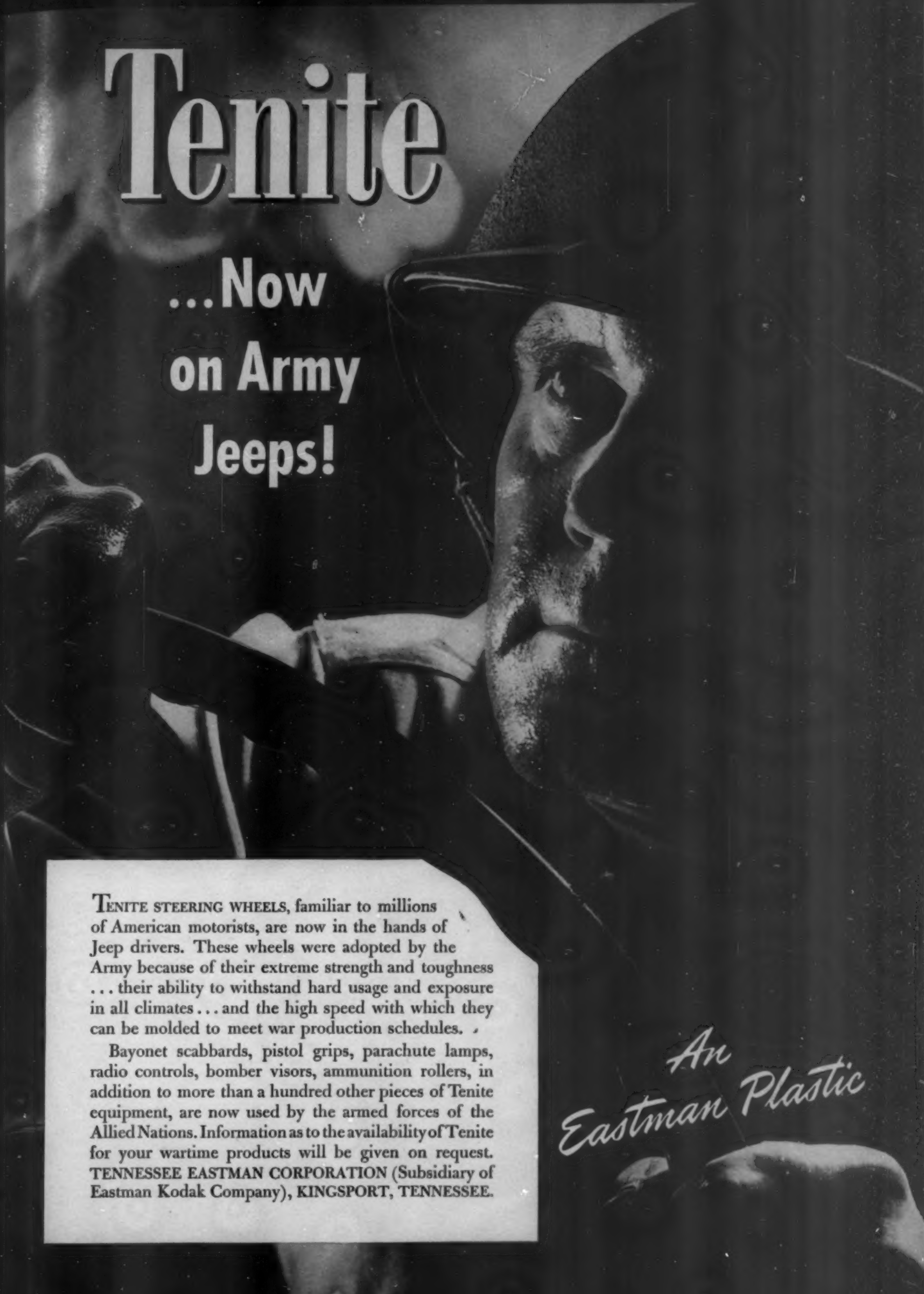
(*b*) *V-notched specimen.* The V-notched specimen for testing materials other than thin sheets shall conform to the dimensions shown in Fig. 4 (*b*). The standard V-notch shall be at the center of the specimen on one side and shall be 0.01 in. in radius and 0.02 in. in depth. The notch shall be formed by milling or shaping in such a (*Please turn to page 132*)

[4] For the purposes of this test a thin sheet shall be defined as a sheet less than 0.3 in. in thickness or a material for which the ratio of the modulus of elasticity to the endurance limit is less than 100. The reason for these restrictions is that thin sheets and materials having a low modulus of elasticity are bent so much under the required loads that the fatigue specimen cannot (in the deflected position) be considered a straight beam and hence the equation $s = \frac{Mc}{I}$ is not accurate. It should be noted that the grips (Fig. 3) may not be satisfactory for specimens of very thin sheet due to the inertia forces set up by the vibration.

2



2—*Fixed-cantilever, repeated-constant-deflection type fatigue testing machine*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Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

TEMPERATURE CONTRASTS IN THE UNITED STATES. S. S. Visher. Scientific Monthly *55*, 239–44 (Sept. 1942). The distributions of several significant temperature conditions in the United States are shown by accompanying maps. They are based on the data for 40 years, 1899–1938, and most of them use records from about 5000 stations. The average annual minimum temperature ranges from 30° F. in central Florida to −40° F. in an area west of Lake Superior. The lowest temperatures recorded range from 20° F. in Florida to −60° F. in Montana and Wyoming. The average annual maximum temperature ranges from 115° F. in New Mexico to 90° F. in northern Maine. The highest temperature observed ranges from 125° F. to 100° F. The influences of various factors on the temperatures of an area are discussed.

AVERAGE PRECIPITATION CONTRASTS IN THE UNITED STATES. S. S. Visher. Scientific Monthly *55*, 446–52 (Nov. 1942). In the United States the range in average annual precipitation is from 1.5 in. at Death Valley, Calif., to 128.6 in. at Quinault, Wash. The average annual precipitation, shown by a map, ranges from 60 in. in southern Florida, Alabama and Mississippi and western Washington and Oregon to 5 in. in southeastern California and part of Nevada. Maps are given which show the average precipitation during various seasons of the year over the United States. This and the preceding article will be helpful in evaluating the effects of outdoor exposures of plastics in various parts of the country.

Materials

COAL AS A SOURCE MATERIAL FOR THE PLASTICS INDUSTRY. R. L. Wakeman and B. H. Weil. Ind. Eng. Chem. *34*, 1387–93 (Nov. 1942). Coal is the chief source for plastics intermediates, basic materials being light oil and coal tar, water gas and coke itself. Seven percent of the benzene produced, 86 percent of the tar acids (natural and synthetic), 66 percent of the naphthalene and all of the coumarone-indene from light oil and coal tar went into production of phenolics, nylon, polystyrene, alkyds and coumarone-indene resins in 1941. Of the 1941 formaldehyde production, close to 75 percent was consumed in the manufacture of the phenolics, ureas and melamines. Intermediates for methylcellulose and the methacrylates were also produced from water gas. Acetylene from calcium carbide is a source for numerous thermoplastics, although coal competes with petroleum hydrocarbons in this field. Both acrylonitrile for synthetic rubber and melamine are produced from coke through calcium cyanamide. While petroleum derivatives, agricultural products and natural resins will provide keen competition, a sound program of research should enable coal to play a vital rôle in future expansion of the plastics industry.

THE ALKYL ESTERS OF PHOSPHORIC ACID. H. Adler and W. H. Woodstock. Chem. Ind. *51*, 516–21 (Oct. 1942). The increased production of phosphoric anhydride, phosphoric acids and phosphorus halides has made economically feasible the manufacture of many organic phosphorus compounds. This article points out many places where such compounds may be utilized, including their use as plasticizers. Specific gravity, boiling point, refractive index and solubility data are given for many neutral alkyl orthophosphates, pyrophosphates, tripolyphosphates, tetrapolyphosphates and metaphosphates. Data on alkyl phosphoric acids and alkyl phosphoric acid salts are also given. The methods of producing these compounds are briefly outlined.

COTTONSEED MEAL IN PHENOLIC PLASTICS. F. Rosenthal. Ind. Eng. Chem. *34*, 1154–7 (Oct. 1942). See MODERN PLASTICS *19*, 100 (May 1942).

Applications

NONMETALLIC BEARINGS FOR STEEL MILL SERVICE. F. W. Vogt. Steel *111*, 78, 80 (July 20, 1942). Bearings made of cotton and phenolic resins have given successful performance in many types of mills. Better wearing properties are made possible by the use of various mineral fillers which constantly polish the roll neck while in operation. The right type of lubrication for each application is important. Water or water mixed with grease is the best lubricant, although oils and greases have been used successfully. Equipment has been developed to use water as a lubricant effectively on dry rolling mills. Some troubles encountered in the use of composition bearings are thrust collar troubles, too tight end-screws, not enough water, water in wrong places and bad roll necks. A summary of power saving expectations in various types of mills is given. This saving varies from 10 to 50 percent. The chief advantages of composition bearings are: 1) power saving, 2) longer bearing life, 3) better section and 4) less down time.

PLASTIC WEDGE COMPENSATOR. C. T. Piecewicz. Rev. Sci. Inst. *13*, 296–7 (July 1942). Cellulose acetate, cellulose nitrate, methyl methacrylate resin and other plastics are recommended as substitutes for quartz in Babinet compensators. The material is oriented by stretching while hot. Plastic wedge compensators have given good service and have been in use for 18 months for studying stresses in injection molded articles.

Coatings

NITROPARAFFINS AS SOLVENTS IN THE COATING INDUSTRY. C. Bogin and H. L. Wampner. Ind. Eng. Chem. *34*, 1091–6 (Sept. 1942). Nitroparaffins are good solvents for the organic esters of cellulose, such as cellulose acetate and cellulose acetate butyrate. Solutions of these materials tolerate appreciable proportions of cheap diluents, such as alcohols and hydrocarbons. Their ideal rates of evaporation make it possible to formulate finishes which duplicate those of nitrocellulose for drying speed and leveling properties. The nitroparaffins show unusual solvent strength for vinyl copolymer resins. While they show no advantage over the ester-type solvents in most nitrocellulose coatings, there are certain specialty applications where their mild odor and different solvent properties have given them commercial applications. Data on dilution ratios, and viscosities of solvent mixtures containing nitroparaffins in combination with cellulose acetate, cellulose acetate propionate, cellulose acetate butyrate, cellulose nitrate and vinyl resins are given.

GLOSS RETENTION AND WOOD-PROTECTION MERITS OF PHENOLIC RESIN-SOYBEAN OIL VARNISHES. A. J. Lewis. Paint, Oil Chem. Rev. *104*, No. 2, 7–8 (1942). A report of out-of-doors weathering tests made on 4 unmodified phenolic resin-soybean varnishes and 2 modified phenolic resin-soybean oil varnishes. Panels coated with these varnishes were exposed for 28 months at Urbana, Ill. The gloss retention and wood protection qualities were evaluated. The four varnishes made with the unmodified phenolic resins were much superior to the two made with the modified phenolic resins.

Technical briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

RELIEVING TOOLING BOTTLENECKS WITH PLASTICS. L. Weiss. Aviation *42*, 114–21 (Oct. 1942). The use of plastic tools and tool molds by Brewster Aeronautical Corp. is described. A casting resin with a range of resiliences which can be varied to suit the job is utilized. This resin, "Formrite," sets with no shrinkage, cures in 4 hours at room temperature, gives a hard, smooth surface, is resistant to water and oil, undergoes no changes in dimensions with changes in atmospheric conditions, withstands intermittent heats to 1000° F., is not critical and is inexpensive. The use of this material not only conserves strategic materials but relieves a bottleneck on skilled tool makers since less labor is involved in preparing tools by this method. Another advantage is speed and lower costs in reproduction of tools and jigs. Twenty-nine photographs and drawings are given which explain how this material may be utilized in making dies, tools, jigs and fixtures.

DENSIFIED LAMINATED WOOD FOR ENGINEERING USES. Engineer *174*, 219–21 (Sept. 11, 1942). A description of "Jabroc" and "Insul-Jabroc," resin impregnated, highly compressed laminated wood products manufactured and used in England. Thin wood veneers are impregnated with phenolic or urea resins and molded at high pressures. The pressure is maintained on the assembly while the platens are being raised to the curing temperature (100° C.), during the curing process and until the assembly is cooled. The pressure used is sufficient to compress the wood to approximately one-half its original thickness. Many types of wood are being used. "Jabroc" has the following properties: specific gravity 1.4, tensile strength 34,000 p.s.i., compressive strength 23,000 p.s.i., shear strengths 3000 and 7300 p.s.i., parallel and at right angles to the fiber, respectively. In some special cases the tensile strength has been raised to 60,000 p.s.i. The material is being used to a considerable extent in the British aircraft industry. Airplane propellers, templates, tools, jigs, fixtures, fan blades, bench tops, acid hoods, railway car parts and ship propellers are being made from "Jabroc." "Insul-Jabroc" is a special grade used in electrical applications.

Chemistry

HEATS OF REACTION OF PHENOL AND FORMALDEHYDE IN ACID AND ALKALINE MEDIA. E. Manegold and W. Petzoldt. Kolloid Z. *94*, 284–94 (Mar. 1942). The temperature rise caused by the reaction started at 90° C. between phenol and formaldehyde in acid or alkaline medium, respectively, was measured in a high-temperature calorimeter which is described in detail. In the acid medium, rapidly progressing exothermic reactions were found, characterized by well-defined temperature jumps preceded and followed by linear temperature-time curves. In the alkaline medium the reactions proceed slowly and the final point could not be established by calorimetric means. The measured temperature jumps are used for calculating the molecular heat of reaction for different molecular ratios.

THE KINETICS OF HIGH ELASTICITY IN SYNTHETIC POLYMERS. R. F. Tuckett. Trans. Faraday Soc. *38*, 310 (Aug. 1942). The Mark-Kuhn theory of high elasticity of rubber is extended to cover the elastic behavior of other polymers which do not attain the stress-strain equilibrium instantaneously. The correspondence of the "elastic temperatures" and Ueberreiter's freezing points is shown for rubber, polystyrene and polyisobutene. It is suggested that Ueberreiter's freezing points as well as the development of high elasticity correspond to the change from a considerably restricted to a relatively free rotation of carbon to carbon bond linkages in the main polymer chain. The "elastic temperatures" of vinyl acetate, methyl methacrylate, styrene, and vinyl chloride resins are given as 35° to 45°, 70° to 90°, 70° to 90° and 100° to 110° C., respectively.

Testing

A TENSION-OPTICAL METHOD FOR THE INVESTIGATION OF CONTRACTION PROCESSES IN PAINT FILMS. W. König. Farben-Ztg. *46* 50–2, 65–7 (1941). An apparatus is described for measuring the contractive forces in paint films based on the fact that isotropic materials such as glass, cellulose nitrate, etc., when subjected to deformation become anisotropic and double refracting. Tests showed that where no contractive forces were present, the life of the film on weathering was much longer than that of films in which contractive forces were present.

Properties

DIELECTRIC MEASUREMENTS ON SOFTENED POLYVINYL CHLORIDE WITH EXTERNAL AND INTERNAL PLASTICIZERS. F. Würstlin. Z. Elektrochem. *48*, 311 (June 1942). The power losses and dielectric constants at 50 cycles of polyvinyl chloride, copolymers of vinyl chloride with butyl acrylate and methyl acrylate, respectively, and polyvinyl chloride plasticized with tricresyl phosphate were measured between 20° C. and 100° C. The power loss curves of all copolymers reach maxima at lower temperatures than the corresponding maximum for polyvinyl chloride. As the amount of plasticizer is increased the power loss maxima occur at lower temperatures. The power loss curves for compositions containing external plasticizers show indications of the maxima corresponding to both components. The maxima of the power loss curves for mixtures containing an external plasticizer are between the maxima for the two components. Mixing copolymers results in a broadening of the region of anomalous dielectric dispersion. The dielectric constant of an externally plasticized polyvinyl chloride increases at the same rate as that of the two components.

VISCOSITY AND CRYOSCOPIC DATA ON POLYSTYRENE. A. R. Kemp and H. Peters. Ind. Eng. Chem. *34*, 1097–1102 (Sept. 1942). From cryoscopic and viscosity data, a K_{em} value for polystyrene of 0.45×10^4 is established for use in the Staudinger viscosity-molecular weight equation. This value is less than one-third that selected by Staudinger. Cryoscopic data at various concentrations are presented on narrow fractions of polystyrene ranging in molecular weight from 300 to 3000. It is shown that solutions of polystyrene in benzene exhibit increasing deviation from Raoult's law as the molecular weight increases beyond about 1000. This fact shows why the present K_{em} value, based only on ideal solutions, is so much lower than Staudinger's value, based on higher polymers whose solutions deviate widely from Raoult's law. It is confirmed that the well-known Staudinger viscosity-molecular weight rule cannot be applied to different polymers. The K_{em} value based on the present work is 5.6×10^{-4}, or more than 300 percent higher than Staudinger's widely used value of 1.8×10^{-4}. A new K_{em} equivalent for one chain atom is calculated for various polymers, based on the number of chain atoms in the base molecule, the K_{em} value, and the weight proportion of chain atoms to the base molecular weight. A wide variety of linear polymers gives K_{em} equivalents ranging from 2.2×10^4 to 4.8×10^4.

The battery, a functional part of certain types of communication systems, might well be called a miniature powerhouse. It supplies the vital electric current. Recently battery builders have found in plastics an admirable material for many component parts as well as the battery case itself. STYRON (Dow Polystyrene) is now being used for these purposes because it provides all the essentials and, in addition, offers definite advantages over the materials that it supplants.

Exceptional electrical properties which make STYRON a remarkably effective insulating medium—extraordinary resistance to chemicals—high impact strength—light weight—these are some of the distinctive characteristics of this crystal-clear molding material that are of great assistance to battery makers. Thus in the field of electricity, as in many others, plastics are making a genuine contribution.

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U.S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

INTERPOLYMERS. H. L. Gerhart (to Pittsburgh Plate Glass Co.). U. S. 2,297,351 Sept. 29. Making clear, insoluble, alkali-resistant resins by interpolymerizing maleic anhydride with a vinyl or acrylic compound.

SAFETY GLASS. Adolf Kämpfer (vested in the Alien Property Custodian). U. S. 2,297,417, Sept. 29. Use of a vinyl acetate or acrylate ester resin as interlayer and a similar resin as adhesive in making laminated glass.

TYPEWRITER BEARING SEGMENT. Johannes Krüger (vested in the Alien Property Custodian). U. S. 2,297,420, Sept. 29. The body portion of a bearing segment for typewriters is molded from a synthetic resin.

HOLLOW ARTICLES. Jakob Dichter (vested in the Alien Property Custodian). U. S. 2,297,459, Sept. 29. Apparatus for making hollow articles from a flowable plastic composition.

EXTRUSION PRESS. Emil Hempel (vested in the Alien Property Custodian). U. S. 2,297,474, Sept. 29. A press for extruding plastic compositions has a driving piston and an extrusion piston.

MOLDING APPARATUS. Pino Salvaneschi (vested in the Alien Property Custodian). U. S. 2,297,504, Sept. 29. A molding machine has a frame carrying a sliding mold plate which is fed from a hopper above the plate.

AUTOMATIC PRESSES. Heinrich Schmidberger (vested in the Alien Property Custodian). U. S. 2,297,505, Sept. 29. Granulating plastics and separating the granules from the fines, for use in automatic molding presses.

STEREOTYPE MAT. A. W. Schorger (to Burgess Cellulose Co.). U. S. 2,297,635, Sept. 29. A plastic stereotype mat composed of felted cellulosic fibers in thermoplastic lignin.

PLASTIC SHEETS. J. Bailey (to Plax Corp.). U. S. 2,297,645, Sept. 29. Extruding a flat ribbon of hot thermoplastic through a nozzle, chilling the edges only and stretching the center while hot.

TREATING PAPER. R. D. Freeman (to Dow Chemical Co.). U. S. 2,297,698, Oct. 6. Improving wet strength of paper towels by treatment with a water-soluble cellulose ether and a urea resin modified with a polyhydric alcohol.

HOT-MELT COATING. T. A. Kauppi and E. L. Kropscott (to Dow Chemical Co.). U. S. 2,297,709, Oct. 6. Nonblocking coatings are formed from a melt of ethylcellulose, hydrogenated castor oil, mineral wax and a natural or synthetic resin.

ALKYD RESINS. R. H. Potts and J. E. McKee (to Armour and Co.). U. S. 2,297,716, Oct. 6. Modifying alkyds with cottonseed oil acids.

STYRENE TYPE COMPOUNDS. F. J. Soday (to United Gas Improvement Co.). U. S. 2,297,722-3-4, Oct. 6. Polymerizing the styrene fraction of light oil with the aid of heat in contact with zinc, magnesium or nickel.

BATTERY COVERS. R. A. Bruner (to General Motors Corp.). U. S. 2,297,741, Oct. 6. A molding press for making battery covers.

SCREW ANCHORS. W. E. S. Strong and C. E. Parsons (to John B. Pierce Foundation). U. S. 2,297,923, Oct. 6. Securing screw anchors in hard-setting moldings with the aid of a magnetic device.

CASEIN FOILS. H. Heckel (to Marbon Corp.). U. S. 2,297,959, Oct. 6. Wrapping foils with high strength, gloss and resistance to low humidities are made from an emulsion of casein and a resin melt.

LIGNOCELLULOSE PLASTICS. W. K. Loughborough (to the Secretary of Agriculture of the U. S.). U. S. 2,298,017, Oct. 6. Plasticizing wood by impregnating it with an aqueous solution of urea or thiourea or their mixtures, and shaping the treated wood.

INTERPOLYMER. G. F. D'Alelio (to General Electric Co.). U. S. 2,298,039, Oct. 6. Interpolymerizing dimethyl itaconate and ethyl methacrylate.

FLASHLIGHT BASE. A. J. Desimone (to Bright Star Battery Co.). U. S. 2,298,042, Oct. 6. A base cap for flashlights is made of molded insulating material.

MOLDING MACHINE. R. W. Dinzl (to Watson-Stillman Co.). U. S. 2,298,043-4, Oct. 6. A molding machine having an advanceable and retractable platen which can be locked against retraction.

MINERAL OIL GELS. W. I. Patnode (to General Electric Co.). U. S. 2,298,066, Oct. 6. Making a stable infusible elastic gel by mixing mineral oil with an acrylate or methacrylate ester of an unsaturated compound.

FACTICE-LIKE PLASTIC. W. Wolff (to General Aniline and Film Corp.). U. S. 2,298,078, Oct. 6. Interpolymerizing divinyl ether or the like with tall oil acid esters of saturated alcohols.

BRUSHES. E. R. Person (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,298,156, Oct. 6. A molded plastic rear face for bristle brushes.

PROTEIN SHEETS. A. W. Ralston (to Armour and Co.). U. S. 2,298,162, Oct. 6. Sheeting a protein solution containing monolaurin or the like.

CELLULOSE DERIVATIVES. Julius Kent. U. S. 2,298,260, Oct. 6. Heating cellulose with formaldehyde before esterification or etherification, to insolubilize alkali-soluble components.

PROTEIN RESIN. F. C. Atwood (to Atlantic Research Associates, Inc.). U. S. 2,298,269, Oct. 13. A water-dispersible resin derived from casein and an alkylamine soap.

SHOE STIFFENER. H. Boeddinghaus (to American Felt Co.). U. S. 2,298,274, Oct. 13. Bonding and compacting a carded mixture of cotton fiber and thermoplastic fibers under heat and pressure.

COATED GLASS FABRIC. C. S. Hyatt and J. C. Lowman (to Columbus Coated Fabrics Corp.). U. S. 2,298,295, Oct. 13. Coating and impregnating flexible glass fabric with an oil-soluble phenolic resin in a tung and linseed oil vehicle pigmented with titanium dioxide. *(Please turn to page 104)*

INSULATED WIRE. R. R. Williams (to Bell Telephone Laboratories, Inc.). U. S. 2,298,324, Oct. 13. Coating an electric conductor with an extruded sheath of a homogeneous isotropic nonhygroscopic polystyrene type resin without plasticizer, and winding filaments of a similar resin around the sheath.

MOLDING WORK PIECES. W. Ernst (to Hydraulic Development Corp.). U. S. 2,298,358, Oct. 13. A hydraulic circuit for molding has a variable delivery pump operating at high or low pressure according to conditions in successive stages of the operation.

MOLD PRESS CONTROL. W. Ernst and P. J. Lindner (to Hydraulic Development Corp.). U. S. 2,298,359, Oct. 13. An improved flow control device for molding presses operates under fluid pressure.

NAME PLATES. J. A. and J. P. Gits (to Gits Molding Corp.). U. S. 2,298,364-5, Oct. 13. Name plates with a molded base and molded lettering.

MOLD PRESS CONTROL. P. J. Lindner (to Hydraulic Development Corp.). U. S. 2,298,393, Oct. 13. The plunger of a hydraulic mold press is fitted with a fluid-operated slowdown mechanism.

MOLDING LENSES. C. V. Smith (Univis Lens Co.). U. S. 2,298,420, Oct. 13. In making lenses from resin composition blanks the pressure is automatically controlled.

MOLDING THERMOPLASTICS. S. T. Moreland, V. E. Hofmann and P. C. Tracy (to Owens-Illinois Glass Co.). U. S. 2,298,716, Oct. 13. A molding machine has a parison mold and a finishing mold, each having separable sections for opening and closing the mold, and means for shearing off and ejecting sprue.

PHENOLIC RESIN. R. E. Burnett (to General Electric Co.). U. S. 2,298,866, Oct. 13. Reacting an aldehyde with phenol or a monosubstituted derivative thereof and a chlorinated aralkyl phosphate or carbonate.

POLYAMIDE FILAMENTS. W. E. Catlin (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,298,868, Oct. 13. Improving the impact strength of synthetic linear polyamide filaments by multiple die-drawing followed by treatment with a nonsolvent swelling agent.

SAFETY GLASS MOUNTING. B. J. Dennison and F. F. Painter (to Pittsburgh Plate Glass Co.). U. S. 2,298,874, Oct. 13. Forming laminated glass with a metal strip anchored in the edge of the plastic interlayer and projecting from it for mounting the sheet in a wall.

PLASTICS FROM OILS. Laszlo Auer. U. S. 2,298,914-5-6-7-8-9, Oct. 13. Modifying fatty oils for use in plastics and paints by heating with a small proportion of an organic acid; or dispersing a cyclic (condensed ring) compound in the oil; or heating with an inorganic acid, an organic sulfur acid derivative, an organic derivative of a nitrogen acid or an organic halide.

PHOTOGRAPHIC FILM. E. C. Yauck and J. Dessauer (to Haloid Co.). U. S. 2,298,997, Oct. 13. A photographic film has a relatively nonflammable regenerated cellulose support bonded by a cellulose ester layer and a gelatin adhesive to the photosensitized layer.

ICE SCRAPER. Bennie Haan (one-half to A. B. Gronberg). U. S. 2,299,089, Oct. 20. A hand tool for scraping ice from windshields is made of a plastic material which is harder than ice but softer than glass.

POLYMERIZATION INHIBITOR. L. W. Codd and F. T. Hamblin (to Imperial Chemical Industries, Ltd.). U. S. 2,299,-128, Oct. 20. Controlling the polymerization of methyl methacrylate by adding about 0.1 percent of acetamide, ammonium carbonate, ammonium carbamate, aldehyde ammonia, pyrrol, piperidine or the like.

TRANSPARENT RECEPTACLE. Wallace Ungemach. U. S. 2,299,194, Oct. 20. Forming the main and side walls and side wall flaps of a receptacle from transparent regenerated cellulose.

SHOE HEEL. A. E. Ushakoff (to United Shoe Machinery Corp.). U. S. 2,299,195, Oct. 20. Attaching plastic heels by softening a portion of the heel, placing it in position and causing the softened portion to interlock with an overhang on the heel seat.

OLEFIN-SULFUR DIOXIDE RESINS. F. E. Frey, R. D. Snow and W. A. Schulze (to Phillips Petroleum Co.). U. S. 2,299,220-1-2-3, Oct. 20. Interpolymerizing olefins with sulfur dioxide with the aid of an organometallic compound, nitric or nitrous acid, a perchlorate or a chlorate.

PLASTIC BUTTON. F. G. Purinton (to Patent Button Co.). U. S. 2,299,493-4, Oct. 20. Reinforced plastic buttons have a hub with axial bore, which may be fluted, to receive the prong of a fastener.

FILM SPOOL. A. D. Cronk and D. S. Hart (to Patent Button Co.). U. S. 2,299,532, Oct. 20. Film spools for cameras have a molded plastic spindle formed in semicylindrical halves which leave a slot for the film when brought together.

MORTAR BONDING GLASS. R. R. McGregor and E. L. Warrick (to Corning Glass Works). U. S. 2,299,552, Oct. 20. A bonding agent for glass building shapes contains a partially hydrolyzed silicate ester plasticized with polyvinyl acetate or a vinyl acetal resin.

MOLDING MACHINE. Jas. W. Appley. U. S. 2,299,724, Oct. 27. A machine for molding plastics has a core box pivoted on a base, and a vibrator for imparting vibrations to the core box.

VINYL RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,299,740-1, Oct. 27. Interpolymerizing vinyl chloride with an acrylate of an alcohol such as chlorobenzyl alcohol; and plasticizing polyvinyl chloride with a chlorobenzyl ester of a polycarboxylic acid.

TREATING TEXTILES. A. E. Battye, J. Tankard and F. C. Wood (to Tootal Broadhurst Lee Co., Ltd.). U. S. 2,299,786, Oct. 27. Improving the wearing quality of textiles by impregnation with an aqueous rubber dispersion compounded with the components of a urea-formaldehyde resin.

CREASEPROOFING FABRICS. C. Dunbar (to Imperial Chemical Industries, Ltd.). U. S. 2,299,807, Oct. 27. Impregnating cellulosic textiles with an aqueous dispersion of a polyethene resin and a urea-formaldehyde or phenol-formaldehyde resin.

GLASS PULLS. M. C. Koester (to Libbey-Owens-Ford Glass Co.). U. S. 2,299.827, Oct. 27. Cementing a glass pull to a sheet of safety glass with a transparent synthetic resin, then simultaneously completing the bonding of glass sheets to interlayer and glass pull to glass sheet under fluid pressure.

INSOLUBILIZING POLYMERS. D. M. McQueen (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,299,839, Oct. 27. Insolubilizing water-soluble synthetic linear polyamide articles by treatment with ionizable salts.

POLARIZING FILM. E. H. Land (to Polaroid Corp.). U. S. 2,299,906, Oct. 27. Making light-polarizing films with a cellulose acetate base, a polarizing layer of molecularly oriented polyvinyl alcohol and a photosensitized layer.

EMULSION POLYMERIZATION. H. Meis and R. Ludwig (to Jasco, Inc.). U. S. 2,300,056, Oct. 27. A butadiene-styrene interpolymer which is plasticizable by oxidation is prepared in aqueous alkaline dispersion in presence of an amphoteric emulsifying agent and a drying oil soap. (*Please turn to page 106*)

BLENDED RESIN. R. Rosen and W. J. Sparks (to Jasco, Inc.). U. S. 2,300,064, Oct. 27. A tough, elastic, water-white blend of a high isobutene type polymer and a practically oxygen-free polyindene resin.

ROSIN ESTERS. A. L. Rummelsburg (to Hercules Powder Co.). U. S. 2,300,065, Oct. 27. Polymerizing rosin or rosin esters with the aid of an acid catalyst and hydrolyzing the product to free the polymer from compounds of the rosin or rosin ester with the catalyst.

OLEFIN POLYMERS. A. C. Skooglund (to Jasco, Inc.). U. S. 2,300,069, Oct. 27. Polymerizing isobutene to a liquid, dissolving it in liquefied ethene and completing the polymerization in presence of boron trifluoride.

ELECTRIC CONDENSER. W. H. Smyers (to Jasco, Inc.). U. S. 2,300,072, Oct. 27. Forming condensers from layers of metal foil faced on both sides with a polyisobutene resin and laminated with layers of Cellophane.

MOISTUREPROOF FOILS. A. R. Olsen (to Hercules Powder Co.). U. S. 2,300,168, Oct. 27. Moistureproofing cellulosic foils with chlorinated rubber which is plasticized with a chlorinated hydrocarbon.

RUBBER CHLORIDE. J. W. Raynolds (to Raolin Corp.). U. S. 2,300,176, Oct. 27. Precipitating rubber chloride from its solutions by contact with a thin layer of nonsolvent which contains carborundum particles and is rotated rapidly so that shearing stresses are set up.

CELLULOSE ESTERS. F. Schulze (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,300,180, Oct. 27. Stabilizing cellulose acetate or like esters by washing out residual sulfate radicals for the acylation bath.

PREFORMED LINOLEUM. F. M. Allen (to Congoleum-Nairn Inc.). U. S. 2,300,193, Oct. 27. Bonding linoleum to a surface by a waterproof assembly comprising an adhesive layer of cumar resin and Portland cement, a sheet of asphalt-impregnated felt and a sealing layer of cumar resin and tung oil.

UREA RESIN. G. F. D'Alelio (to General Electric Co.). U. S. 2,300,208, Oct. 27. Condensing urea with formaldehyde or furfural in presence of malononitrile.

CONTACT LENSES. A. F. Dittmer (to Bausch and Lomb Optical Co.). U. S. 2,300,210, Oct. 27. An improved form for making negative molds to be used in making contact lenses having a glass corneal lens and a scleral rim of moldable plastic.

DRY CASTING FILMS. W. C. Eberlin (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,300,211, Oct. 27. In casting films from solutions the flow of solution through the extrusion orifice is made slower at the ends than at the middle of the orifice.

CELLULOSE ESTERS. F. T. Flaherty and A. McAlevy (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,300,213, Oct. 27. Esterifying cellulose with formic, acetic, propionic or butyric acid in presence of a boron trifluoride complex having water or an acid or ester as the other component.

TAPE. F. W. Humphner (to Mid-States Gummed Paper Co.). U. S. 2,300,224, Oct. 27. Veneer tape comprising a paper base, a lacquer film and a layer of paper impregnated with a heat-responsive resin, bonded to the paper base but not too firmly to be stripped away.

MOLDING MACHINE. C. R. Johnson, S. L. Handforth and R. E. Smith (to Remington Arms Co.). U. S. 2,300,290, Oct. 27. Means for continuously molding articles from plastic compositions and ejecting the articles from the mold.

SHOT SHELL SEAL. J. Harmon (to Remington Arms Co.). U. S. 2,300,368, Oct. 27. Sealing the ends of shot shells with milled cyclized rubber containing 25 percent of a phenol-formaldehyde-methylamine resin.

COATED PAPER. F. R. Stoner, Jr., and D. M. Gray (to Stoner-Mudge, Inc.). U. S. 2,300,373, Oct. 27. A greaseproof, chemically inert coating for paper contains a Vinylite type resin and a blend of such a resin with maleic anhydride or an alkyl maleate.

ROSIN ESTER. R. C. Palmer (to Newport Industries, Inc.). U. S. 2,300,433, Nov. 3. A stable high-melting ester of a polyhydric alcohol and a hydrogenated rosin polymer

MOLDINGS. A. P. Mazzuchelli (to Bakelite Corp.). U. S. 2,300,458, Nov. 3. Moldings with a surface which does not tend to laminate under friction are made from ethylcellulose of a specified viscosity range.

MOUNTING SPECIMENS. H. L. Gerhart (to Pittsburgh Plate Glass Co.). U. S. 2,300,495, Nov. 3. Embedding biological and other specimens in a solid transparent styrene-maleic anhydride resin.

INTERPOLYMERS. H. J. Hahn and E. Braun (to General Aniline and Film Corp.). U. S. 2,300,566, Nov. 3. Emulsion polymerization of vinyl compounds in presence of interpolymers formed from a vinyl or methacrylate ester, styrene or a vinyl ether and maleic anhydride or crotonic acid.

VINYL RESIN ADHESIVE. A Menger (to General Aniline and Film Corp.). U. S. 2,300,587, Nov. 3. Blending a partially depolymerized chlorinated vinyl chloride resin with a polyvinyl ether.

SEALING CONTAINERS. Earl R. Rehfeld. U. S. 2,300,-594, Nov. 3. Apparatus for applying a plast'c seal to containers by forcing the plastic through openings in a mold element in the container closure.

MODIFIED ALKYD. H. A. Bruson and J. L. Rainey (to Resinous Products and Chemical Co.). U. S. 2,300,645, Nov. 3. Reacting the free hydroxyl groups of an alkyd resin with a condensation product of formaldehyde and a bisthioammeline polyalkylene ether.

INJECTION MOLDING. Alfonso Amigo. U. S. 2,300,759, Nov. 3. Improved apparatus for making shaped articles from synthetic resins by injection molding.

MOLDING REINFORCED RESINS. A. Amigo (one-half to Ebonestos Industries, Ltd.). U. S. 2,300,760, Nov. 3 Molding articles from laminations or sheets of resin-impregnated felt in successive stages in each of which only the surface is hardened during molding.

EYEGLASS FRAMES. H. E. Spooner (to Bay State Optical Co.). U. S. 2,300,834, Nov. 3. Attaching metal parts to plastic spectacle frames with the aid of a lacquer.

PRINTING INK. D. R. Erickson and P. J. Thoma (to Michigan Research Laboratories, Inc.). U. S. 2,300,880-1, Nov. 3. The resin ingredient in a varnish for printing inks is rosin modified with maleic anhydride or the like, together with a polyglycol or a terpene.

INTERPOLYMER EMULSIONS. W. Heuer (to General Aniline and Film Corp.). U. S. 2,300,920, Nov. 3. Stable aqueous emulsions of interpolymers formed from vinylsulfonic acid and another vinyl compound.

MOLDINGS. A. B. Rypinski (to Metropolitan Device Corp.). U. S. 2,300,974, Nov. 3. A device having two elements secured by an internally threaded fastener is made of a molding composition.

THE BIG GUN

of the Peace to Come

The biggest gun in the arsenal of America, in war or peace, is technical proficiency and engineering progress . . . To more effectively serve the war effort, and prepare for the progress of the future, Formica, now as for years past, is concentrating the energies of a considerable engineering and research staff on the problem of improving laminated plastic material and adapting it to new uses—that there may be better insulated electrical devices, better control for airplanes, better instrument panels, better ignition for all internal combustion motors, more resistant parts for chemical industries . . . If you have problems which might be solved by such a plastic material, this staff will be glad to give you their time and effort in attempting a solution.

FORMICA

THE FORMICA INSULATION CO. • 4673 SPRING GROVE AVENUE • CINCINNATI, OHIO

Machinery and Equipment

★ THE TORIT DUST COLLECTOR (ABOVE) MADE BY Torit Manufacturing Co., St. Paul, Minn., is a recent addition to that company's line of machinery. The unit draws the dust-laden air from hoods surrounding polishing or grinding wheels down through a compartment behind the motor in the cabinet, and then up through a set of filter bags. There is a tray beneath the bags which receives the heavy particles. The steel cabinet contains the motor, fan, fan housing and a set of chemically treated, spark-resistant filter bags.

★ A NEWLY DESIGNED UNIT FOR THE MANUAL control of remote valves, dampers and other pneumatically operated equipment is announced by the Foxboro Co., Foxboro, Mass. Specifically designed for dead-end service, this remote valve control unit will, according to the manufacturer, hold reduced pressures to values within very narrow limits. It may be used also to set control points of distant instruments or to adjust pressure-producing pistons located at inaccessible points.

★ FROM MARBURG BROS., INC., 90 WEST ST., NEW York City, comes a description of their new duplex die and punch filing machine which, according to the manufacturer's report, is easily adaptable for both operations. It is equipped with an upper and lower table, both 10 in. square, and accurately ground to accommodate the average run of dies and punches. The file support is of a recessed design and the file holders are guided in prismatic ways with adjustable gibs. The ball bearing crank drive is adjustable in its stroke from 0 to $1^1/_2$ in. and can be set to accommodate a proportionate range of depth requirements. In the die filing operation, the upper table is swivelled into working position, and the file holder operates from below. In the punch filing operation, the upper table is tilted out of the way, and the punch file operates from the top. The lower table may be adjusted up to 10° toward front or rear.

★ A NEW REPEATING CYCLE TIMER ALSO KNOWN as the "Blow-Down Timer" has been developed by the Taylor Instrument Companies, Rochester, N. Y., to facilitate the purging of condensates from various types of curing or molding equipment, and as an aid in creating adequate heat distribution. This repeating cycle timer may also be used, the makers say, in conjunction with a diaphragm motor as an aid in controlling the duration as well as the period of the blow-down cycle.

★ TWO RECENT ADDITIONS TO THEIR LINE OF AIR clamps are announced by Mead Specialties Corp., 15 S. Market St., Chicago, Ill. One is the H4 clamp, said to be adaptable to many forms of milling operations and assembly jigs. The second item is a new type of foot control for the clamps. The use of the foot control releases the operator's hands for use in feeding work to the drill press.

★ THE DRY BLENDING MACHINE (BELOW) FROM Sturtevant Mill Co., Dorchester, Boston, Mass., is a compact, selfcontained batch mixing unit which is being manufactured by that company in sizes up to and including $3^1/_2$ tons. It is described as having been specially designed for primary and color mixing in the plastics industry, and will blend any number of ingredients of any density or specific gravity. It is pointed out by the manufacturer that it has four separate blending actions with no unmixing or separating effects. Special features are claimed to be its self-cleaning properties, explosion-protection features and its dust-tight construction.

Publications

Write direct to the publishers for these booklets. Unless otherwise specified they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

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Chemical Engineering Catalog, 1942–43

Published by Reinhold Publishing Corp., 330 West 42nd Street, New York

Price $3.00 **1336 pages, illustrated**

This volume, the twenty-seventh annual edition of the Chemical Engineering Catalog, is a complete and authoritative compilation of standardized data on equipment, machinery, laboratory supplies, heavy and fine chemicals and raw materials used in the process industries which employ chemical processes of manufacture.

Divided into three main sections, Chemicals and Raw Materials, Equipment, and Technical Book Section, the subject matter under each heading has been carefully indexed and cross-referenced to facilitate handling.

The technical and scientific books section, which catalogs and describes briefly a comprehensive list of books on chemicals and related subjects, adds to the value of this volume as a reference source.

Although the book may be purchased outright, the Reinhold Publishing Corp. follows its established custom of distributing it without charge to responsible individuals in the chemical industry who can turn in last year's volume in exchange for the current edition. L. C. A.

Control Chart Method of Controlling Quality During Production

American War Standard Z1.3-1942

American Standards Association, 29 W. 39th St., New York

Price $0.75 **41 pages**

This publication was prepared by a Government-industry committee, at the request of the War Department, to provide for the application of statistical methods to the quality control of materials and manufactured products. The method is especially recommended where inspection can be performed by sampling only. Where inspection is 100 percent, the method is useful for controlling the percentage of rejections. The work involved is largely engineering, based on judgment, knowledge of the processes and technical skill in tracking down unwanted causes of variations to their source. The computations require only simple arithmetic.

Breaking the Skilled Labor Bottleneck

by Eugene J. Benge

The National Foremen's Institute, 511 Fifth Ave., New York, 1942

Price $2.00 **47 pages**

This little manual was compiled as the result of a study of a possible impending labor shortage undertaken by the National Foremen's Institute in 1940. The advent of war, and the attendant full-scale mobilization of industry for war production which has revealed acute skilled labor shortages, make this little volume an unusually timely one. The study reveals that full and proper utilization of existing skills would go far toward ameliorating the labor situation. The thesis holds, on the basis of the study, that labor shortages—particularly those in the skilled labor fields—may be avoided or overcome by careful subdivision of skills coupled with supervised intensive training based on reliable aptitude tests, and careful study of personnel records. Charts, graphs, diagrams and tables recording results of the study supplement the text. It is a study that might be read with profit by many administrators in various industries that are today confronted with the problem of a skilled labor bottleneck. L. C. A.

★ "THE DEVELOPMENT POSSIBILITIES OF PAPER For War Industry" is the title of a booklet, prepared by Byron Weston Company of Dalton, Massachusetts, which describes some of the uses of paper as a solution to certain problems of materials shortages. Containing a fully illustrated description of the company's laboratory and production facilities, the booklet explains that paper has as yet undeveloped possibilities of usefulness in the great war production program, being readily subject to plasticizing, laminating molding, impregnating, coating and other specialized treatments.

★ TWO NEW FOLDERS, ONE ON THE "1100" SERIES 20-in. drill presses and the other on radial drill presses have been issued by the Walker-Turner Co., Inc., Plainfield, N. J. Photographic illustrations and charts are supplemented by textual explanations of the presses, their individual uses, operating methods, etc.

★ NEWEST EDITION OF A CONDENSED CATALOG listing various products of air conditioning equipment made by Carrier Corp., Syracuse, N. Y., is now available for distribution Included is a listing of the firm's products according to their functional classification, and those industries requiring the different types of installations. Illustrations and full specifications of each unit are also included.

★ FOUR BOOKLETS RECENTLY MADE AVAILABLE BY the Carbide and Carbon Chemicals Corp., 30 East 42nd St., New York City, comprise a valuable library of information about the Vinylite resins. The first of these booklets, *Vinylite, Polyvinyl Acetate Resins*, discusses the various forms of this material produced by the Company, describes their forms, characteristics, applications, and includes such technical information as is required for the successful formulation of the material. Tabulation of properties, grades of the various forms, tables showing solubility of the material, all add to the value of this little booklet as a quick and ready reference.

Vinylite Rigid Sheet Plastics is the name of the second booklet, the purpose of which is to provide specific information to fabricators on correct procedures for machining, forming and finishing Vinylite plastic rigid sheet. It also contains a description of the material including the forms in which it is produced, sizes of sheets and general characteristics and properties.

Vinylite Resins encompasses a discussion of the properties of these materials and the forms in which they are produced.

Fabrication of Vinylite Plastics by Screw Extrusion is designed to furnish information about methods of extrusion for rigid, semi-rigid and flexible materials in this classification.

★ "FORMICA PLASTIC SURFACES," A BULLETIN just released by the Formica Insulation Co., Cincinnati, Ohio, discusses the use of the company's laminated plastic as a decorative surfacing material. The booklet is profusely illustrated, and a 2-page color chart gives examples of the variety of surface textures and colors that may be obtained with Formica.

★ NATIONAL VULCANIZED FIBRE CO., WILMINGton, Del., makes available in a handbook, "Phenolite," technical and descriptive data on laminated Bakelite. Properties of the material, grades of sheet and tubing available, directions for machining and typical uses of the product are discussed.

(Please turn to page 152)

Washington Round-Up

Current news, Government orders and regulations affecting the plastics industry, with analyses of the plastics situation

PHENOLICS ORDER

Effective December 1, 1942, phenolic resins and phenolic resin molding compounds were put under complete allocation and end use control by General Preference Order M-246. The order bars delivery or use of phenolic resins or phenolic resin molding compounds without specific authorization by WPB, and will guarantee that the output of the phenolic materials industry will be channeled into essential needs. Certain exceptions to these restrictions are made, including orders under 55 gallons per month.

Because the number of vital end-products made from these materials is so great, the WPB thought it not practical to restrict rigidly in advance all end-products in which the resins might be used. Therefore, persons seeking resins and compounds for use in certain end-products (such as plywood, protective coatings, laminates, molded products and the items on List A of the Order) are required to file certificates with their suppliers specifying end-use in considerable detail. This enables the producer to indicate to WPB the end-use of the product for which he seeks phenolic materials, and enables WPB to allocate so that the most essential needs will be met.

This certificate must be in substantially the same form as the one contained in the order. It must specify end-product in as much detail as possible, such as "Navy, torpedo boat, bulkhead," not "Navy" or "torpedo boat," or "bulkhead."

The standard chemical allocation forms, PD-600 and PD-601, are to be used in applying for authorization to sell, deliver, accept delivery of and use.

Molders, laminators and fabricators should pay particular attention to section (e) of the order which provides for a certification of consumer use as follows:

(1) Any person seeking to purchase from the manufacturer thereof any plywood (including shaped plywood and shaped impregnated wood), protective coating, laminate, molded product or any of the products listed on Schedule A attached hereto, made in whole or in part from any phenolic resin or phenolic resin molding compound, shall, at the time of placing his order for such product, file with his supplier a certificate specifying the ultimate use to which such product will be put. Where such a certificate is supplied in connection with any order it shall not be necessary to file additional certificates in connection with deliveries made from time to time in fulfillment of such order. Such certificate may be placed on the purchaser's purchase order and shall be in substantially the following form:

> The undersigned hereby certifies that the product covered by the accompanying purchase order will be used solely for the production of the products and materials listed above and that said products and materials will be used only for the purpose or purposes designated.
>
> ....
> (Name of customer)
> By..........................
> (Signature of authorized official)
>
> Date:.................... Title:......................

The above certificate shall constitute a representation to (but shall not be filed with) the War Production Board.

(2) The certificate provided for in paragraph (e) (1) hereof shall be sufficiently specific to enable the purchaser's supplier to indicate product use on his application for phenolic resins or phenolic resin molding compounds pursuant to paragraph (f) (1) (vi) hereof. Allocations of phenolic resins and phenolic resin molding compounds will be based on specific use of each product, and it is, therefore, essential that information with respect to product use be as precise as possible. For example, specify "Navy-torpedo boat-bulkhead" not merely "Navy," "torpedo boat" or "bulkhead." In cases where orders are made for inventory, the purchaser must indicate prospective product uses, and in the event a prospective use does not materialize, the purchaser shall not use the product made from phenolic resin or phenolic resin molding compound purchased for such use without authorization of the Director General for Operations. Applications for authorization may be made by letter directed to the Chemicals Branch of the War Production Board, Ref. M-246, setting forth the material facts. Such letters shall be certified by the applicant in substantially the following form:

> The undersigned applicant certifies to the War Production Board that the information contained in this letter is complete and correct.
>
> ....
> (Name of applicant)
> By..........................
> (Signature of authorized official)
>
> Date:.................... Title:......................

MATERIAL SUBSTITUTIONS

The War Production Board issued on November 6 the sixth Material Substitution and Supply List, prepared by the Conservation and Substitution Branch of the Conservation Division. Listed in Group I (materials which are vital to war needs and supplies of which are inadequate) were the following plastics raw materials:

Copolymers of:
  Vinyl acetate
  Vinyl chloride
Ethyl cellulose
Methyl methacrylate:
  Molding compound
  Sheet
Phenolic laminates
Phenolic laminated rods
Phenolic laminated tubes
Phenolic molding compound
Phenolic resins
Polystyrene
Polyvinyl acetate
Polyvinyl alcohol
Polyvinyl butyral
Polyvinyl chloride
Polyvinyl formal
Vulcanized fibre:
  Heavy sheets
  Some medium sheets

In Group II (materials which are also essential to war needs but supplies of which are currently in approximate balance with immediate demands) were the following:

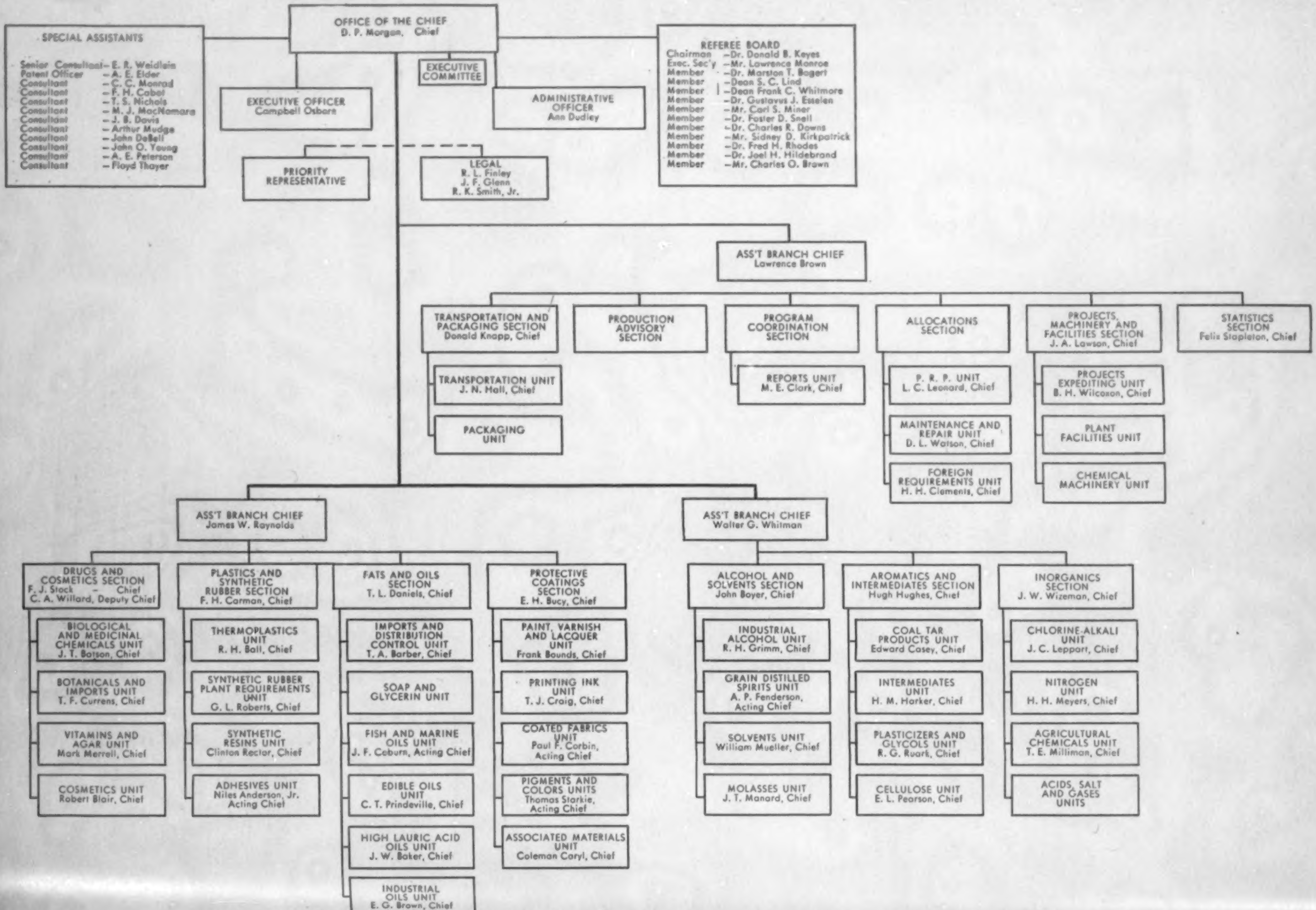
Cellulose acetate
Cellulose acetate butyrate
Cellulose nitrate
Melamine resins
Urea-formaldehyde resins
Vinylidene chloride
Vulcanized fibre:
  Thin sheets
  Some medium sheets

Casein and lignin were the only plastics placed in Group III (materials which are used to some extent in the war effort, which are available in quantities exceeding demand and which are recommended as substitutes for scarcer materials).

CHEMICALS BRANCH

The chart on the opposite page gives the new set-up of the Chemicals Branch of the WPB. (*Please turn to page 114*)

CHEMICALS BRANCH, W. P. B.



CONTROLLED MATERIALS PLAN

WPB has announced the beginning of a new priorities plan known as the Controlled Materials Plan which will eventually be the master priority pattern replacing PRP. Steel, copper and aluminum are thus far the only materials to which the plan will be applied.

Roughly, the idea of the plan is to put available materials exactly in balance with demand. Idea is to allow the armed services to handle their own needs by allocating to each branch a percentage of the "controlled" materials available. The armed service concerned will then allot its share of the materials to each of its prime contractors who will make certain that no more material is used on each job than has been allotted. Thus a heavy burden is placed on the prime contractor in checking his subsuppliers as to material usage. But Washington feels that decentralization of "checkups" in this manner will prove more expeditious and quicker than having all reports on materials usage flow through WPB headquarters and field offices.

Chemicals have not yet been put under this plan but indications are that they probably will be. This will mean additional record keeping and collation of statistical data by molders, laminators and fabricators.

Complete explanation of the new plan can be obtained upon request from the nearest WPB field office.

PRICE CONTROL

An arrangement regarding control over prices of war goods along lines already in effect has been announced by the War and Navy Departments and the Office of Price Administration. The agreement was worked out by Under Secretary of War Patterson, Under Secretary of the Navy Forrestal and Administrator Henderson.

In general, OPA will refrain at this time from further extension of its controls over military materials and services. Accordingly, military items, their sub-assemblies and parts, which now are exempt from OPA regulations, will in general be left to control by the War and Navy Departments. Materials, sub-assemblies and parts of these items, and finished goods that have close civilian counterparts, which now are under OPA regulations, will in general remain there with special provisions for price adjustments under Procedural Regulation No. 6.

The War Department and the Navy Department will use all their powers to control profits and prices on the items exempt from OPA control and left to their jurisdiction. They will exercise such controls by the use of procurement procedures based on experience gained since the war began and by full use of their broad powers to examine and audit production costs and renegotiate contracts.

Firms selling military items should take care to determine whether their sales are subject to OPA regulations or are under price control of the War and Navy Departments. The exemptions from the OPA regulations are, of course, contained in those regulations. It is emphasized that no sales heretofore subject to OPA control have been exempted as a result of the new arrangement. The procedure for handling requests for adjustment of OPA ceiling prices on war items is provided by Procedural Regulation No. 6. Under it, decisions on the applications will be reached expeditiously.

ADVISERS ON SYNTHETIC TEXTILES

The Army has appointed a special committee, composed of nationally known chemists, fiber and textile authorities to serve as a clearing house between the Quartermaster Corps and the synthetic fiber industry on all technical matters relating to the utilization of man-made fibers and textiles in Army equipment procured by the Quartermaster Corps, the War Department announced today.

The committee, operating under the supervision of the Office of The Quartermaster General, Washington, includes: Professor E. R. Schwartz, Massachusetts Institute of Technology; Lewis Hird, Samuel Hird & Sons; William Klopman, Burlington Mills; Dr. Harold DeWitt Smith, A. M. Tenney Associates; Col. Max O. Wainer, President, The Quartermaster Board; Lt. William H. McLean and Richard R. Walton (Secretary of the Committee), both of the Research and Development Branch, Office of The Quartermaster General.

Directly responsible for the committee's activities on behalf of the War Department is Colonel Georges F. Doriot, Chief of the Research and Development Branch, Office of The Quartermaster General.

A technical sub-committee, operating under the main committee, has also been appointed. It consists of the following: Dr. Harold DeWitt Smith, A. M. Tenney Associates, Chairman; Dr. Ernest Benger, du Pont Company; Joseph Meierhans, J. P. Stevens Company; and C. E. Geier, Duplan Corporation.

CHEMICALS

The chemical plant facilities industry committee of WPB at its first meeting in Washington last week, considered the need for converting plants for increased production of critical materials. These include ethyl cellulose, ethyl alcohol, dibutyl amine, diethyl amine, ethyl aniline, furfural, mannitol, sorbitol, monochlor benzene, phenol, thiokol, triacetin, tricresyl phosphate, triethyl phosphate, acetanilid, aluminum chloride, calcium carbide, calcium hypochloride, dichlorethyl ether, silica gel, acrylonitrile, polyvinyl formaldehyde resins and carbon black.

• • •

Classification Symbols—The end-use classification symbols provided for by Priorities Regulation No. 10 have been abolished. However, brass mills, copper wire mills and copper foundries must continue to use the symbols. To avoid delays in delivery, all persons ordering copper and copper-base alloy products from mills and foundries are warned that they must provide as much end-use information as possible, including the ACS symbol number, so that their suppliers may obtain the necessary allocation of metal from WPB to fill their orders.

• • •

Phosphate Plasticizers—Phosphate plasticizers have been placed under complete allocation by an amendment to General Preference Order M-183, effective November 6, 1942.

• • •

Maintenance and Repair—The top priority rating of AA-1 now may be applied to essential repair and maintenance needs of the nation's essential industries. Until the Controlled Materials Plan goes into full operation, the existing priorities system will be used to obtain the steel, copper and aluminum needed for such maintenance and repair. Under CMP, each agency will break down its material requirements three ways: into that needed for production, construction and facilities, maintenance and repair.

• • •

Nylon—Nylon waste—used in the manufacture of such civilian fabrics as "Nylon fleece"—will henceforth be available only for purchases directly connected with the war, the WPB ruled. The order prohibits consumption of Nylon wastes for any purpose other than the manufacture of spun Nylon yarn. When produced, the yarn can be used only for supplying requirements of the Army, Navy, Maritime Commission, War Shipping Administration and Defense Plant Corporation. It is estimated that 3000 pounds of Nylon flake will be recovered a month, in addition to the yarn made from the waste material.

• • •

Office of Technical Development—Appointment of a committee of engineers and scientists to determine the manner in which this projected office is to be set up within the WPB, and to define the scope, functions and method of operations which it should have, was announced recently by WPB Chairman Donald M. Nelson. Chairman of the new committee is Webster N. Jones, Director of the College of Engineering, Carnegie Institute of Technology

In the plastics picture

★ MECHANICAL PROPERTIES OF RUBBER AND plastics were among the subjects discussed at the annual meeting of the A.S.M.E. in New York on Dec. 3. The complete program of the Rubber and Plastics Group's sessions was as follows:

SESSION 1—PLASTICS

1. "Mechanical Tests of Cellulose Acetate, Part III," by William N. Findley, Associate in Theoretical and Applied Mechanics, College of Engineering, University of Illinois, Urbana, Ill.
2. "Physical Properties of Laminated Plastics," by R. W. Barber, Chief Engineer, Panelyte Div., St. Regis Paper Co., Trenton, N. J.
3. "The Effects of Continued Heating on Mechanical Properties of Molded Phenolic Plastics," by D. Telfair, R. U. Haslanger and T. S. Carswell, Plastics Div., Monsanto Chemical Co., Springfield, Mass.

SESSION 2—RUBBER

1. "Data on Static and Dynamic Fatigue of Rubber," by Francis L. Yost, U. S. Rubber Co.
2. "Rubber Substitutes," by E. G. Kimmich, Div. Engineer, Goodyear Tire and Rubber Co., Akron, Ohio.
3. "Progress in Plastics and Rubber During the Past Year," by Gordon M. Kline, National Bureau of Standards, and F. L. Yerzley.

★ THE CHICAGO CHAPTER OF THE SOCIETY OF Plastic Engineers came into existence on the evening of October 30 at a dinner meeting held at the Manufacturers' Club at the Merchandise Mart in Chicago. Organized primarily to establish a medium for the exchange of knowledge, information and technical data among the engineers, designers and other individuals connected with a technical or scientific aspect of the plastic business, the Chicago Association is to work closely with the Association of Plastic Engineers in Detroit. In the absence of the president, the meeting was presided over by the first vice-president, J. J. Bachner, of Chicago Molded Products Co., and was addressed briefly by Mr. Bachner, W. T. Cooper of Bakelite Corp. and C. C. Henry of Chicago Die Mold Co.

A complete set of by-laws was formulated and adopted and the following men were elected to office:

John J. Bachner, Chicago Molded Products, 1st vice-pres.
W. F. Cullon, Celluloid Corp., secy.-treas.
W. T. Cooper, Bakelite Corp.
W. M. Ellison, Richardson Co.
C. C. Henry, Chicago Die Mold
Lee T. Bordner, Eclipse Molded Products
R. H. Moorhouse, Cardinal Corp., pres.
A. W. Nelson, Sinko Tool Co.
J. O. Reinicke, Barnes & Reinicke, 2nd vice-pres.

Meetings are to be held at least once a month, with a technical program arranged in advance for each meeting. In charge of making such arrangements is a new Technical Committee appointed by the President and composed of the following:

W. L. Hess, Chairman, Sandee Manufacturing
C. A. Dassing, Bakelite Corp.
R. Lindholm, Chicago Molded Products Corp.
J. O. Reinecke, Barnes & Reinicke
J. C. Kazimier, Chicago Molded Products Corp.
R. Bauspies, Midwest Molded Products Corp.

W. T. Cooper of Bakelite Corp. was appointed chairman of the Membership Committee.

★ R. H. MACY & CO., INC., NEW YORK CITY, ANnounces that the exhibit of substitute materials developed in the U. S. which the company had planned to hold early in 1943 has been postponed. Reasons for making this decision are set forth in a letter which the editors of MODERN PLASTICS recently received from Jack I. Straus, president of the company, and which is reproduced here for the information of readers who had planned to cooperate in the exhibit:

As you know, Macy's has been planning an extensive exhibit of substitute materials which have been developed in this country. We have been very much gratified by the expressions of interest which have come from every side: government, industry, the press. There seems to be general agreement that this show, properly timed, would serve a highly useful purpose, and would stimulate interest among the public and industry alike. However, conditions change quickly today and we are now faced with severe restrictions which did not exist a short time ago. As transportation and manpower needs have become more critical, and as inventory restrictions have become more imminent, we have recently encountered some questioning as to whether, in the light of present conditions, it was appropriate to hold the exhibition at this time.

After careful scrutiny of all aspects of this problem, we have decided to postpone the exhibit. It is our feeling that we can best cooperate with the government's war effort by temporarily foregoing the extensive transportation and construction work involved in the staging of such an ambitious event. We intend to continue our explorations into the whole field of substitutes so that we may hold the exhibit as soon as it is practical to do so, even if this means waiting until after the war. From an examination of the material already gathered, it is apparent that the exhibit when it is held will be one of the most forceful and dramatic shows ever seen in New York. We feel that Mr. Bert Bacharach has made an outstanding contribution in assembling this material, and he will continue to represent us in this field.

Mr. Bacharach and Mr. Stern have told us of your fine cooperation, and I want to thank you for myself and in behalf of the members of our organization. We are deeply appreciative of the interest you have shown in our project, and look forward to the time when we may resume working with you to bring the exhibition to a successful conclusion.

Sincerely yours,

November 11, 1942 JACK T. STRAUS, *President*

★ SPEAKING BEFORE THE ADVERTISING CLUB AT Worcester, Mass., on Nov. 18, Herb Spencer, advertising manager, Durez Plastics & Chemicals, Inc., asked his audience to think about the postwar period and told why his company chose to discuss it in its advertising. "We could not justify the claim that our resins and plastic compounds were winning the war, for 50 pounds of Durez resin in a PT boat or a few ounces in a bayonet handle do not make a victory," said Spencer. "The industry that fails to plan ahead will be left behind by whose who have planned. No matter what you make, changes will come; new production methods, new materials, new cost structures, scientific developments are going to affect the postwar period. True, there is a war to win and it is getting the right-of-way. We are not neglecting this from the manufacturing phase of our business.

"Today many organizations are thinking of tomorrow. Resin-bonded plywood bathtubs have been experimentally manufactured. The American Rolling Mill Co. is making resin-bonded pipe. Dehydrated foods are with us to stay. It has been recently stated that in Chicago 1 dwelling in 5 is suitable for decent living conditions; that 150,000 have no private bathing facilities. I believe we shall see come out of the war small radios, something adapted from the types used by the Army. They logically should have plastic housings. In the present-day stove for cooking, there is a great deal of waste space in the shell or body. With electricity there is no reason why (as Barnes & Reinecke, industrial designers, have contended) the hot plates couldn't be

located, with drawers beneath, in convenient parts of the kitchen. Photography is going to play a much greater part in business for permanent records. Plastic furniture, for which a great deal is predicted, will come about and not, I hope, along the line of some of the early experiments. It has the advantages, of course, on a production basis of eliminating finishing, sanding, sawing, cutting etc., to a large extent.

"Production methods of today turned to peacetime production will permit many things to be made in volume, and profitably, at lower prices than we have been accustomed to paying. Housing should be one of the outstanding postwar markets—low-cost housing. Forty-two percent of the thirty-seven-odd million dwellings in the U. S. are without private baths; 4,000,000 are not fit for human habitation. Economists making studies for Johns-Manville, General Electric and the National Resources Planning Board this year agree that the country could absorb somewhere between 1,200,000 and 1,500,000 homes a year for a decade after the war, and that this presents a six billion dollar market annually. New homes on this scale mean additional schools, churches, movies, stores, etc.

"The result of our postwar planning theme in advertising has been somewhat surprising to us, to see how generally manufacturers are thinking along lines of the postwar period. Our type of copy has attracted their attention and many interesting contacts have resulted. Advertising results are exceeding anything we have received for a number of years. Interesting is the fact that those answering our advertising include an exceptional number of heads of very large organizations, and now one of the problems becomes the means of keeping them interested until such a time as we might be in a position to do business with them.

"If there is meat in what I have been saying, I believe it is this: If you are confined to war production, devote some time to postwar products your organization will have to sell. Watch new materials and your competitors, for plastics and low-priced metals and the production skills developed in war manufacturing will bring in many new and low-priced products. Styling will be different from where we left it in 1940 or 1941."

★ JAMES H. SAVAGE, OF THE PLASTICS DIVISION OF Colt's Patent Fire Arms Mfg. Co., is now plastics consultant of WPB's Bureau of Industrial Conservation, replacing Gus Holmgren, who has gone to the Plastics Section of the Navy's Bureau of Ordnance.

★ REICHHOLD CHEMICALS, INC., DETROIT, MICH., announces that it is now producing synthetic rubber from soy beans on a commercial scale. Called Agripol, this chemurgic rubber has been under experiment by the company and the U. S. Government for over a year.

★ HAWLEY PRODUCTS CO., ST. CHARLES, ILL., MANUfacturer of molded cellulosic and allied plastic products, has founded an industrial fellowship at the Mellon Institute, Pittsburgh, Pa., for the purpose of conducting an investigational program of importance to our armed forces. Dr. J. C. Williams, an alumnus of Oberlin and Iowa State College, a specialist in cellulose chemistry and plastics technology, has been appointed to the incumbency of this fellowship. He will be assisted by Peter Shanta, a chemical engineer from the University of Pittsburgh, and will have the constant cooperative aid of experts in the Institute and in the donor's organization.

★ THE ARMY-NAVY "E" FOR EXCELLENCE IN WAR production was last month awarded to the employees of the Eclipse Aviation and Pioneer Instrument Division of Bendix Aviation Corp., Bendix, N. J.

★ GROBET FILE CO. OF AMERICA, DISTRIBUTORS OF Swiss pattern files and rotary files, announces its removal to larger quarters at 421 Canal St., New York City.

★ METHODS OF STORING, HANDLING, FABRICATing, repairing and maintenance of transparent Plexiglas aircraft sections are shown for the first time in a 20-minute sound film just released by Rohm & Haas Co., Philadelphia, Pa. The film, which was photographed at the company's factories and at aircraft manufacturing plants, covers most of the points that aircraft workers, ground crews and flying personnel should know about transparent plastics now used for noses, observation domes, gun turrets and cockpit enclosures in a majority of U. S. war planes. Available in 16-mm. sound film only, it may be borrowed by educational institutions and aircraft manufacturers at no cost upon written request to Rohm & Haas Company, Plastics Division, 222 West Washington Square, Philadelphia, Pa.

★ AMERICAN PEDESTRIANS WILL TAKE HEART AT the news that Elliot E. Simpson, Director of the L. Dressage Shoe Co., 29 W. 34th St., New York City, has just perfected a new shoe sole made of non-strategic, priority-free materials. Rubber and leather have been entirely eliminated. Since his patent application is still pending, Mr. Simpson will divulge only that the material is a thermoplastic combined with a fabric and molded together under heat and pressure. The combination gives a new shoe sole that is flexible, water-proof, tough and resilient. Simpson claims that the union of the fabric with the plastic material is such that the thermoplasticity of the plastic is controlled, and it is rendered impervious to weather and temperature changes. The plastic material used, according to Mr. Simpson, is priority-free, available in abundance, colorful, durable and—more important—exceedingly wear-resistant. The soles are in production now, and have already reached the market in both popular and high-priced shoe fashions.

★ THE INDEPENDENT PNEUMATIC TOOL CO. ANnounces new locations of its branch offices in Boston, Mass., and Birmingham, Ala. The Boston office, managed by Vance G. Turner, is now located at 78 Brookline Ave., and the Birmingham office at 1411 N. Third Avenue.

★ DR. CHARLES ALLEN THOMAS, DIRECTOR OF THE Central Research Laboratories of Monsanto Chemical Co., last month addressed a St. Louis meeting of 1800 sales executives representing a cross section of American industry. Of the place of plastics in the postwar world, Dr. Thomas had the following to say: "The infant plastics industry has already invaded fields previously sacred to products such as metals, wood and stone. The mechanical engineer and the plastics engineer will get together and make tougher and more durable plastics that will be used in home building as well as for the structural parts of motor cars and planes."

★ EMPLOYEES OF THE SOUTH BEND LATHE WORKS, South Bend, Ind., have received their third production award this year—the joint Army-Navy "E" with Star. Other awards received by the company in 1942 are the Navy "E" Ordnance award and the All-Navy "E."

★ MATHIESON ALKALI WORKS, INC., OF NEW YORK City, speak for the chemical industry as a whole when they ask all receivers of chlorine, ammonia, carbon dioxide and other compressed gases to return their shipping cylinders to the producers promptly. No new cylinders can be obtained, the company says, and the number being diverted from civilian use to the war effort is increasing daily. It is therefore necessary to keep the available supply in constant circulation, and to cooperate with transport companies in arranging shipments that can be handled economically.

★ A SERIES OF INDUSTRY OPERATIONS CHARTS, enabling manufacturers in four important light industries to tell

Plastics ←

SCRAP

→ **WILL HELP WIN THIS WAR**

- Plastics are strategic materials—we make it our specialty to conserve them by salvaging all scrap and rejects.
- We sell reground molding materials of all kinds and colors to substitute and save virgin molding powder.
- We buy scrap and rejects at fair prices and guarantee grinding if desired.
- Complete custom service: We regrind, remove all metals, sift and separate, and reclaim contaminated plastics materials.
- Cellulose Acetate, Butyrate, Polystyrene, Methyl Methacrylate, Vinyl Resins, etc.

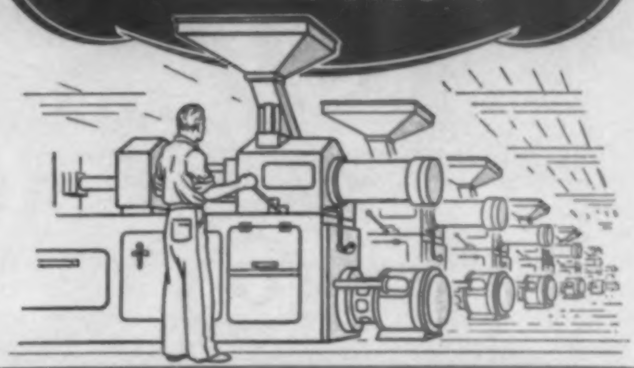
A. BAMBERGER

PLASTICS MOLDING MATERIALS

109 South 5th Street ★ Brooklyn, N. Y.

Cable: Chemprod — Telephone: EVergreen 7-3887

UNDERLYING ALL Waterbury Plastics PRODUCTION



EXPERIENCE

EXPERIENCE is the cumulative result of having licked a problem so many times it's no longer a problem. Without experience, the best-intentioned effort may be little more than experiment . . . and experiment belongs in the laboratory, not on the customer's cost record!

"Waterbury" experience dates from the beginning of commercial plastics in this country. In that time, the original "plastic" has split into a score of resins, and endless delicate tints and vivid colors. The products themselves have progressed from buttons, knobs, balls, cups and other simple forms to the most involved assemblies of plastics and metal. And the one-time narrow latitude of density is now a wide range from almost flinty hardness to extreme pliability.

Ability to supply this modern medium for war production is what is offered you in "Waterbury Plastics". If you have a war production problem in plastics, contact us. And if you are looking ahead to peace time production, let us help you to "Plan with Plastics".

Waterbury Plastics

THE WATERBURY BUTTON CO.
WATERBURY, CONN., U. S. A.

EST. 1812

at a glance what war items they can make, has been issued by N. Y.-Northern N. J. office of WPB, Regional Director John F. McKernan, in charge of production service, announces. Charts cover needleworking, woodworking, plastics, and leather and canvas goods industries depict in simple, graphic form manufacturing operations necessary to production of more than 300 items regularly bought by Army, Navy and other war procurement agencies. Data are also included on such newly developed items as wooden parts for gliders and trainers, and plastic components for shells.

★ THE SUBSTITUTION OF PLASTICS FOR CRITICAL metals in non-essential civilian goods cannot be continued indefinitely because of the rapidly expanding needs for many of these plastics for war production, Ralph H. Ball, chief of the Thermoplastics Unit, Organic Plastics and Resins Section of the War Production Board, reported at the National Chemical conference held at the Hotel Sherman, Chicago. Warning bluntly that plastics can no longer be utilized by civilian industry as a cure-all for the metal shortages, Mr. Ball said that the majority of plastics now in general use "are available in insufficient quantity to meet war and essential civilian needs, and many of them are inadequate for war use alone." He cautioned also that attempts by industry to promote civilian goods made from even those plastics which now appear most plentiful would be "hazardous" in view of the critical supply situation in prospect for virtually all plastic materials. New developments dependent upon plastics, he advised, "should be confined to essential items which will be a real contribution toward winning the war."

Mr. Ball cited two major factors as being responsible for the failure of plastics output to keep pace with increasing military needs: lack of adequate production facilities and shortages of chemical raw materials for their synthesis. The supply problem in plastics is equally divided between these factors, he said.

"It is a mistake to think that we can expand production plants for this or that plastic at will," he noted. "We have already sponsored a number of important plant expansions during the last year, but the chances for additional new construction appear remote. It looks as if we will have to get our supplies from the plants already built or building."

Regarding chemicals used in the production of plastics, Mr. Ball forecast that the ability to secure adequate supplies of these will depend largely on whether "the use to which the plastics are being put are more important to the prosecution of the war than other competing uses for the same raw materials." Among the major shortages of chemicals for production of plastics are those of phenol, benzol, nitric acid, cresol and various materials used as plasticizers, he said. Shortages of ammonia, cotton linters and octyl alcohol, all used for some type of plastics, are also threatened, he said. The shortages of nitric acid and cotton linters will probably restrict the nitrocellulose plastics, the oldest of the plastic materials, to "supply essentials," he noted. Mr. Ball also predicted that cellulose acetate plastics, although still produced in large quantities, will not be sufficient to meet all civilian demands. Many of the lower plastics are already limited to war uses, he said.

"We face these plastics-supply problems because plastics have gone to war," he concluded. "They are playing a vital rôle in our war production and military supplies. In many cases these military uses are entirely new developments, conceived during this emergency by the technical and production men of the chemical industry."

Sorry!

★ THROUGH AN OVERSIGHT, SUNDBERG & FERRAR were not credited with the design of the phenolic register housing described on page 71 of the November issue under the title "Case history of a register."

Defense training in plastics

by CARL E. HOLMES

Men and women from all walks of life, from executives to stenographers, both young and old, have enrolled in the classes in industrial plastics given by the Engineering Science and Management Defense Training Program (ESMDT) of the U. S. Office of Education. They want to learn more about plastics and how they can prepare themselves to join in what they sincerely believe is one of the country's leading industries of the future.

Schools at which these classes are held have received so many inquiries from other universities all over the country asking for information about material used, how competent instructors are obtained, copies of the curriculum and any other assistance that will help them satisfy the public demand for classes in plastics in their localities, that Modern Plastics *has asked Mr. Holmes to write this article, showing how a typical course is set up and run.*—ED.

ENROLLMENT is for a ten weeks' period. Two and one-half hours each evening, two evenings a week, are devoted chiefly to lectures prepared by instructors obtained from local plants associated with the plastics industry, such as molding plants, mold makers, materials sales engineers or designers.

It is quite obvious that the field of plastics is so broad that a limited amount of time will have to be devoted to any one phase of the industry. To allow the students to acquire a general knowledge of the subject in such a short period of time, therefore, it is advisable not to spend too much time on the chemical analysis of the numerous materials, but to show how a few of the most popular are made and to list the basic materials in most of the others, as suggested in the following condensed schedule:

PLASTIC RESINS

PHENOLICS:

Thermosetting, wide range of colors, except pastels.
Basic raw materials are coal, air, wood, water.
High heat resistance.
Compression molded, extruded, injection molded.
Automobile, aircraft parts, telephone equipment.
Electrical insulators.

PHENOL-FURFURAL:

Thermosetting.
Basic materials, oat hulls, coal.
Compression and injection molded.
Mechanical and electrical parts.
High heat resistance.
Limited color range (black and brown).

UREAS:

Raw materials, coal, air, wood, water (ammonia, carbon dioxide, carbon monoxide and hydrogen gases).
Unlimited colors.
Compression and injection molded.
Odorless and tasteless.
Thermosetting.
Tableware, buttons, plywood and veneer bonds.
Baking enamels, housings, closures.

MELAMINE:

Thermosetting.
Raw materials, lime, coke, air.
Higher heat resistance than phenolics.
Odorless, tasteless, colorless.
Used for laminating and electrical purposes.
Wide range of colors.

(*Please turn to page 122*)

★ ★

THE PLASTICS INDUSTRY DECLARES A DIVIDEND

This issue of Modern Plastics numbers 10,000 copies, an increase of one thousand over the regular guaranteed distribution of this magazine.

Next month, January, will set another new high: 10,500 copies will be printed and will continue to be printed every month until further notice.

These increases have been forced, literally, by an overwhelming tide of reader interest that has raised Modern Plastics' paid circulation to new heights each month; until there were just not enough copies to go around. They are a reflection of the expanded use and application of plastics in every war industry and product. They are, in the truest sense, a dividend declared by the plastics industry.

There will be no increase in space rates.

MODERN PLASTICS

BRESKIN PUBLISHING CORPORATION

122 E. 42nd Street New York City

★ ★

Acrylic:

Thermoplastic.
Superior transparency.
Permanence of dimensions.
Weather resistant.
Aircraft and marine enclosures.
Dental teeth and inlays.
Dresser sets and tableware.

Vinyl Ester:

All vinyls are thermoplastic.
All vinyls are synthetically made.
Control properties by molecular weights and plasticizers.
Application governs physical properties.
Unlimited color range.
Basic source of raw materials, coal, air, salt, water, nitrogen, gas.

Vinylidene Chloride:

Thermoplastic.
Synthetic resin.
Unlimited colors.
Odorless, tasteless, non-toxic.
Will not burn.
Injection, compression molded, extruded.
At 350° F., it decomposes in contact with steel or iron so we nickel or chrome plate it.
Woven and braided fabrics are developing rapidly.
House screens.
Injection molded pump parts, couplings, gaskets, valves.

Styrene:

Thermoplastic.
Raw materials, coal, petroleum.
Unlimited color range.
Only plastic with metallic ring.
Injection, extrusion, compression (rare).
Lowest moisture resistance of all solvents.
Affected by all types of solvents.
Odorless, tasteless.
Dishes, bottle closures, edge lighted instruments.
Refrigerator parts.

Acetates (acetates, butyrates, nitrates and ethyl cellulose):

All thermoplastic.
Unlimited color range.
All used for films and lacquers.
All used in decorative field.
All injection, compression and extrusion molded.
All easily machined.
All start off with cotton.
Wood is basic source of cellulose.

Alkyd:

Applications in the paint fields.
Long-oils, printing inks, house trim.
Short-oils, low baking enamels for metal finishes.
Raw material, coal.
Air-drying and non-drying

Coumarone-Indene:

Thermoplastic.
Mastic tile floors, protective coatings, transcription records.
Wide color range.
Resistance to acids, alkalies, brine water.

Caseins:

Thermosetting.
Raw materials, skim milk or proteins, coal, to obtain formaldehyde.
Unlimited colors.
Easily machined.
Nonflammable.
Injection, compression molded and extruded.
Buttons, buckles and game novelties.

Shellac:

Thermosetting and thermoplastic.
Electrical insulation, phonograph records, protective coatings.
Hardness, high gloss and resilience.

Lignin:

Thermosetting.
Raw materials, scrap wood and farm by-products.
Greater heat resistance than ureas or phenolics.
Limited color range.
Recommended for mechanical uses.
Masnoite lignin plastic is used as wallboards.

Cold Molded:

Heat resistant, low cost materials.
Rapid molding cycle.
Roller skate wheels and handles on cooking utensils.

The curriculum decided upon by the instructor will often vary in accordance with his experience in his particular branch of the industry. In fairness to the class, their desires should be ascertained before a curriculum is definitely decided upon and a majority will necessarily have to be the governing factor. The following suggested curriculum is one that will meet the needs of the majority of mixed classes.

History of plastics—recent developments and industrial uses. How plastics are being used in the defense program	$2^1/_2$ hr.
Study of the physical properties of the various materials and why they are adapted to their specific uses	5 hr.
Materials used in the manufacturing of molding compounds and illustrated procedures on a few of more common compounds	$2^1/_2$ hr.
Molding equipment. Compression, injection, transfer and extrusion	5 hr.
Molding technique	$2^1/_2$ hr.
Parts design	5 hr.
Mold design. Compression, injection, transfer and extrusion	10 hr.
Cold hobbing and mold engraving. Mold steels. Heat treatment	$2^1/_2$ hr.
Physical, mechanical and chemical tests	$2^1/_2$ hr.
Laminating processes. Cast resins	$2^1/_2$ hr.
Finishing, inspection, shipping	$2^1/_2$ hr.
Molding plant layout, selection of equipment, maintenance cost analysis	3 hr.
Final examination	$2^1/_2$ hr.

A textbook is very essential to permit the students to get a better understanding of the lectures, and many discussions have developed as to the proper choice, but experience has proved that the Plastics Catalog is a book that will serve this purpose admirably. It contains complete data on all materials, methods of manufacture, latest developments and is highly recommended.

Local molding companies are usually very cooperative in donating samples of molded parts for students' inspection, and these are extremely helpful to instructors in demonstrating molding technique and mold design. Thin wall samples of injection molded parts are desirable to show the necessity of maintaining even wall thicknesses for the elimination of shrink marks. Poorly molded pieces, such as non-fills, under-cures, over-cures, or pieces showing any other defects may be used to illustrate the cause of such defects. It is much easier for the instructor to make his points if the students can see for themselves exactly what he is trying to impress upon them.

Boonton gets the Army-Navy "E"

THE Boonton Molding Company and its employees became the first custom molders to receive the Army-Navy "E" award for excellence in war production work in ceremonies held at the plant in Boonton, N. J., on November 4.

The "E" burgee was presented to George K. Scribner, President of Boonton, by Major Howard E. Norris, Army Air Force, and lapel pins with the "E" emblem were presented to all employees of the company by Lt. J. Douglas Gessford, U.S.N.R.

The "E" pennant may be flown at the Boonton plant for six months and at the end of that period the Joint Production Award board of the Army and Navy will review the record of the company. Satisfactory performance during the period will mean the addition of a star to the pennant.

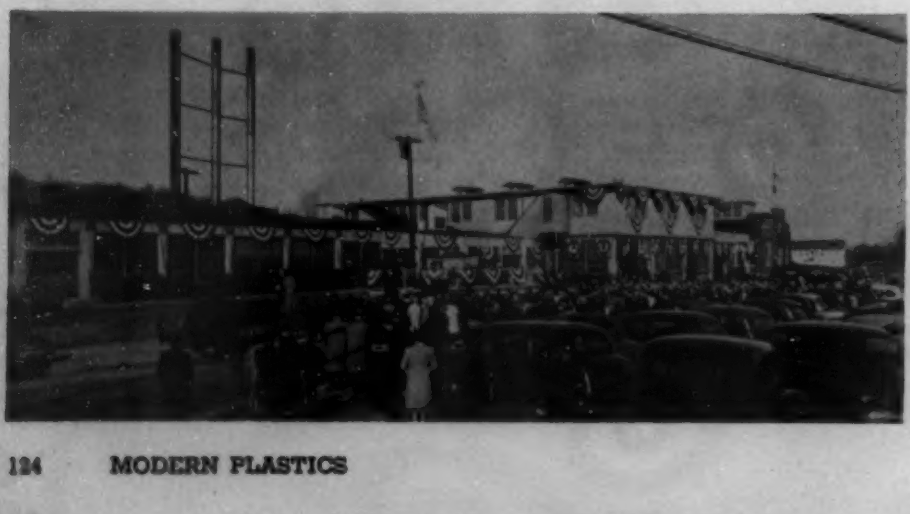
Nicholas J. Burggraaff, personnel manager of the company, acted as master of ceremonies and told those attending that "We have joined our hands . . . to see that freedom shall ring in the land of the free and the home of the brave."

He then introduced the honor guests, including Ronald Kinnear, President of the Society of the Plastics Industry, Freeholder John Roach, Jr., Mayor of Dover; Stephen C. Griffith, Director of the Board of Freeholders; Freeholder William Spargo; Charles A. Breskin, publisher of MODERN PLASTICS magazine; William T. Cruse, executive vice-president of SPI; Mayor Fred C. McCoy of Boonton; Judge James V. Beam and Oscar Myers.

Mr. Scribner pointed out that the ceremony had a double significance because, he said, 35 years ago the molded plastics industry was started in Boonton. "Now," he told the crowd, "I am proud to say that the Boonton plant is the first custom molder of plastics to receive the coveted Army-Navy "E." Mr. Scribner then introduced the pioneer workers in the plant: John Koval, Nicholas Creatura, Arthur Reeves, Charles Lucas and George Stefanik.

John Koval, representing the employees, said that it was a great honor and source of deep personal satisfaction to every worker of the company. "We will strive constantly to keep up our standard," he concluded.

The singing of "America" concluded the program.



London Letter

PLASTICS IN WARTIME BRITAIN

An exclusive survey of developments during three years of war

In many senses, this war may be said to have "made" the plastics industry—or, at least, to have hastened its growth to maturity by a good many years. Before the war most plastics materials were still largely used for decorative or novelty purposes, as containers for toiletry articles, as basic materials for various domestic utensils, as cigarette holders and cases, and so on. Wartime developments and conditions have resulted in plastics being introduced into a host of new industries, and put to use (successfully) in ways which had not previously been thought possible. In this article I should like to give readers in your country a concise picture of how the war has affected the plastics trade in Great Britain, from the first of September 1939 up to the present—with a few ideas as to postwar prospects. Such a picture, reflecting many wartime trends and emergencies which you have yet to face, may be of some help to you in your own planning for the future.

First, some facts about the control position. Early in the war our authorities probably did not fully realize the important part that plastics were going to play in the production field. As a result there was no immediate control of materials, as I see there has been in your country, and it was not until one whole year of war had passed that the Plastics Control Department of the Ministry of Supply was set up, with Sir Vyvyan Board as Controller, "to license sale and consumption of molding powders and synthetic resins and to operate certain voluntary schemes of control." One of the Control's first acts was to issue the Control of Plastics (No. 1) Order, S.R. and O. 1669 (October 1, 1940) which laid down that licenses must be obtained for the sale or usage of any plastics molding powders made from formaldehyde, phenol, cresol, urea, thio-urea or cellulose acetate. About twelve months later, in November 1941, a Control Order (No. 2), S.R. and O. 1722, was issued, extending the provisions of the first Order to cover synthetic resins in the production of which formaldehyde, cresol, phenol, urea or thio-urea had been used. A representative list of some of the actual commodities now covered by our Plastics Control system is given in the box below. The present Plastics Controller is now Mr. L. P. B. Merriam, with Mr. C. H. Glassey as Deputy Controller, and the offices of the Plastics Control are Universal House, 56 Buckingham Palace Road, London, S.W.1., Great Britain, telephone number Sloane 9985.

So much for the control framework. As to the actual supplies, we have naturally had to limit imports as far as possible. As a consequence, there has been an encouraging increase in home production of such useful materials as polystyrene, polyvinyl chloride, polyethylene. There are fairly plentiful supplies of coaltar in Britain, and the fact that this is the base in the preparation of many of the most important plastics has helped to obviate any desperate shortage. However, in cases where supplies of essential materials have been cut off—as was so with casein following the 1940 invasions in Europe—arrangements have quickly been made to ensure supplies from an alternative source. In this instance, dangers of a bottleneck were avoided by the setting up of a Lactic Casein Importers' Association to handle allocation and distribution of supplies by license, by arrangement with producers in the Argentine. Imports of synthetic materials such as polyisobutylene and polyvinyl acetate have been maintained from America and Canada, on a scale sufficient to meet requirements. Following the loss of so much of the world's rubber supplies, the British Plastics Control has also been concentrating on building up stocks of methyl methacrylate, both from home and overseas sources. This material is used, in particular, for the manufacture of denture plastics—in which, it is claimed, Britain has now built up a world priority of supplies.

Against this productive background our plastics industry—which is now estimated as employing some 100,000 workers—has steadily changed over from peace to war production. First, the introduction of Limitation of Supplies Orders restricted manufacturers' civilian output to 25 percent of the prewar figures. Next, complete bans were brought in on production of a number of products, such as fancy toys, fountain pens, umbrella handles and other nonessential goods. In the early part of the war, manufacturers were still encouraged to build up their export trade, and one firm, British Industrial Plastics, Ltd., had an annual export income amounting to £200,000. However, with the later swing to urgent economy measures, the British Plastics Export Group nobly cancelled its big export drive and manufacturers, not without some natural heart-burning, volunteered to forsake their valuable export fields and concentrate on 100 percent war production. At about this time, too, the Ministry of Labour and National Service applied Essential Works Orders to the molding powder manufacturing, molding, manipulating and fabricating branches of the plastics industry, thus ensuring an adequate supply of labor for the important new jobs being undertaken by plastics firms.

Not surprisingly, a large section of our plastics production resources are now being applied to the expanding aircraft industry. Panels, gears and bearings, windscreens, insulating materials, plywood fuselages and aeroplane engine blanks made of wood-filled urea-formaldehyde are among some of these applications, while many others cannot, of course, be mentioned until after the war. Phenolic plastics are being used as protective coatings for various fittings; acrylics are being extensively utilized in production of windshields, gun turrets, escape hatches, etc.; laminated phenolics are also being used for production of covers and hangar floors, etc. In other heavy industrial fields, increasing use is being made of polyvinyl chloride compounds and allied plastics materials for insulation of cables. A new laminated plastics material with a wood facing, produced by Bakelite, Ltd., is being introduced into the electrical and aircraft industries, being very useful for strengthening of sheets under strain, for example. An improved form of resin densified wood, made by the New Insulation Co., Ltd., of Gloucester, and marketed under the name Permali, is being used in the electrical industry. Permali consists of laminae of wood, vacuum impregnated with synthetic resins, afterwards compressed together without any bonding other than polymerization of the resins.

One of our biggest plastics companies gives the following particulars of its applications of urea molding powders for war purposes: 1) an ivory translucent molding powder is being used for making mess deck lighting shades for warships; 2) a urea sheet tinted with light mottle is being used in large quantities for cutting up into panels, these being laced together to make general lighting shades for ships; 3) a chronometer case molded in white from a material which does not tarnish and which is unaffected by electrical influences is produced for use by the Admiralty; 4) wood-filled urea-formaldehyde is used for production of large quantities of molded transit plugs for shells, and for the molding of small cylindrical containers for holding compasses; 5) special plastics tumblers and other tableware are made for use on submarines, one of the most interesting examples being a graduated tumbler of stout section to give it great strength, this also forming part of equipment of rafts and lifeboats.

In the more specialized sections of amino plastics, this same firm has been responsible for developing a gap-filling cement for use in aircraft construction. The glues are moldproof and waterproof, besides having the added advantage of easy working and rapid setting, and are used in several spheres of aircraft production, as well as in such marine work as the production of laminated launch stems, cleats, etc. Another important development has been the production of melamine on a commercial

WARTIME CONTROL OF PLASTICS

Commodities covered by the British Plastics Control, in addition to specific resin and molding powder materials:

Artificial horn made from casein (sheets, rods, tubes)
Celluloid (sheets, rods, tubes, films, etc.)
Cellulose acetate (sheets, rods, tubes, films, etc.)
Di-isobutylene
Fibestos (cellulose acetate sheet)
Methyl methacrylate (Perspex)
Paratertiary amyl and butyl phenol

Nylon polymer	Polystyrene
Phenol	Polythene
Parahydroxydiphenyl	Polyvinyl acetate
Phthalates	Polyvinyl chloride
Polyisobutylene	Rennet casein

scale by a patented process which requires no high pressure plant. The melamine is used for production of a hardener for urea-formaldhyde cements, conferring on these resistance to boiling water for periods in excess of three hours. This hardener is approved by the Ministry of Aircraft Production for the manufacture of aircraft plywood to Specification 5. V. 3, which calls for boiling water resistance. Melamine is also being used for the production of resins for stoving lacquers and enamels having extreme hardness, great fastness to light and excellent water resistance.

Plastics wartime developments in more general fields include the very large scale development of molded buttons to replace metal and ivory nut, a great increase in production of urea-formaldehyde molded bottle caps to replace metal caps, production of millions of lamp shades for A.R.P. and other purposes (mainly from opaque powders), the production of a large number of electrical accessories in urea-formaldehyde materials in place of former phenolic materials required for other purposes; and, last but not least, the development of urea-formaldehyde molding powders to produce utility drinking vessels such as mugs, beakers and cups (but not saucers). In this instance, in order to economize in raw materials, manufacturers and the Ministry of Supply agreed on the production of one standard color, ivory. It is estimated that 10,000,000 plastics drinking vessels will be available, equal to no less than $^1/_8$ of the total production of utility crockery. Finally, mention should be made of an interesting new arrangement, following a proposal of the British Plastics Federation, that plastics firms should manufacture plastics tokens for British restaurant meals, on behalf of the Ministry of Food. The Ministry has suggested an initial order for 2,250,000 tokens, and the Federation has also received many inquiries from borough and urban councils for the production of molded plastic meal tokens produced to individual designs.

Two technical developments over here which may interest firms in your country have taken place during the war. One is the development of manufacturing of reinforced plastics from both fabric- and paper-base materials. Resins for impregnating the fabric or paper are of the phenolic or cresylic type, and are made on the spot. Impregnated material is then pressed up and parts machined from the sheets. The other development is that of plastic mats to carry printed text. For some time these had been made to carry and reproduce illustrations for overseas journals, but now that they can be used for text as well, they are in increasing demand by propaganda departments of the British and Allied Governments. Principal advantages of the mats are their lightness and virtual indestructibility. They offer great possibilities in color printing, owing to their plastic base being less affected by contraction and expansion than the ordinary stereos and electros. Main use of the mats is for overseas publicity because their lightness—and the fact that they can be stuck to any base by an adhesive incorporated in the finished product—offers special advantages over heavier competitive products. These mats have been developed by C. and E. Layton, Ltd., and E. S. Hole and Co., Ltd. (while the reinforced plastics are made by Erinoid, Ltd.).

In the plastics machinery field, mention should be made of a new laboratory molding press that has been manufactured by Apex Construction, Ltd. The press is made in a range up to five and ten tons, and the electrically heated platens are thermostatically controlled. Another company, Voss Instruments, Ltd., has brought out an improved fixed contact thermometer made to specification from 20° C. to 200° C. for general commercial work, and, if necessary, made up to 400° C. In another field, resistance to corrosion and abrasion in valves of the lubricated plug cock type has been improved by use of a new coating, which is of the welded type and applied to revolving surfaces of plugs and bodies and to other portions. Coating has high hardness and corrosion resistance, combined with a low frictional coefficient. It will keep its hardness almost unchanged at temperatures of 540° C., according to reports, and in resistance to corrosion it is practically equal to stainless steel. Rebuilding of worn parts by a stainless spraying process is another development, while another patented process employs a metallic spray of hard steel over a master design, building it up to such a thickness that it is possible to employ it as a finished mold, or if thinner, set into a separate backing.

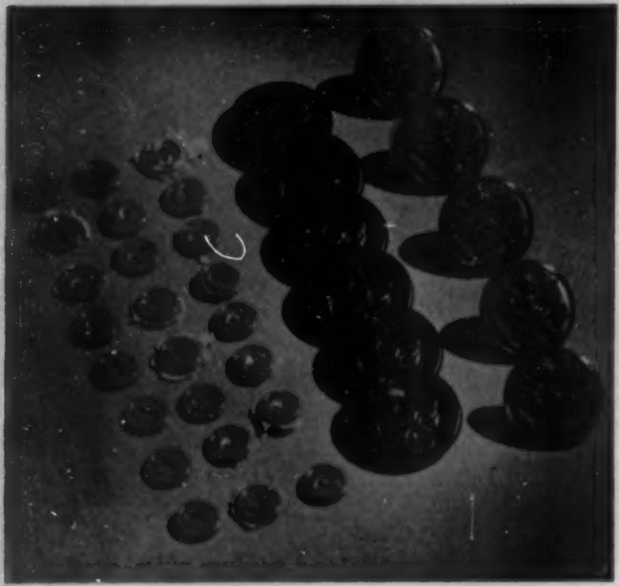
I should like to conclude with some reference to the organizational and administrative side of the British plastics industry in wartime. In previous articles I have commented on the welcome increase in fair and square trade cooperation that has been noticed since war started. This has continued, largely through the good work of the British Plastics Federation, which has acted as a redoubtable spokesman for the industry. The Federation has set up its own Post-War Planning Committee, which is reputed to have worked out a number of important schemes for postwar application; but Gilbert T. Beach, secretary of the Federation, insists that "deliberations of the Committee are confidential to the Council of the Federation." However, details are available of one interesting development, and that is in regard to the usage of plastics in the inevitable postwar building drive. A Plastics Committee of the Ministry of Works and Buildings has been set up, consisting of representatives of the British Plastics Federation, officials of the Ministry of Works and Building (recently renamed Ministry of Works and Planning, by the way), of the Building Research Station and the Royal Institute of British Architects. This committee is now working on plans for the extended application of plastics to heating and ventilating, lighting, plumbing, electric, gas and mechanical installations, painting, internal and external furnishings and building construction. In regard to this planning, Sir Herbert Morgan, chairman of a number of plastics companies, including British Homophone, Ltd., Crystalate, Ltd., and Ebonestos Industries, has prophesied that after the war British firms will be producing plastics mantelpieces, panelling and doors.

Before the war, British plastics development was held back, among other reasons, because of the intrusion of scores of small firms with limited capital and experience, out for quick profits, careless about the harmful effects of cut-throat competition. Now that the war has resulted in a greater welding together of the industry, and the shedding of many past prejudices, it is felt that the trade as a whole is much readier to occupy the important place undoubtedly awaiting it in postwar industrial developments. Unlike many other trades, the plastics trade is a new one, with many fields yet untouched, so that even when the big demands of war industries cease, there will be immediately available new and equally big demands, both in former home markets and in new markets—particularly, as is constantly stressed over here, the building market. For these reasons, the leaders of the British plastics trade are both pleased with their contributions toward war production and optimistic about postwar products. These views are evidently widely held, since there has recently been an extraordinary development of investments in plastics companies' shares—a fact which, I think, can be taken to be as good an indication of future prospects as anything else. (*Denys Val Baker. Mailed Oct. 24, 1942.*)

Army gets new buttons

(*Continued from page 45*) furnish buttons for Russia and Britain. The Russian button industry has suffered severely from German aggression, and production in Kharkov, Kiev and Stalingrad, former button centers, has been drastically curtailed. In Britain the production of buttons from plastic materials is increasing tremendously and is a major effort of the plastics industry in the United Kingdom. They are being used to replace metal buttons on military uniforms and for "utility" suits for wartime wear. These buttons are reported not to break in the mangle and to keep their smooth finish indefinitely.

One factory is producing buttons at the rate of 100,000,000 annually and plans to reach the rate of 300,000,000 by the end of 1942, says the British press. This tripled output will require a staff of only 200 persons. A machine recently installed is turning out 5760 buttons an hour. Buttons for uniforms can be made at the rate of 2880 an hour, and it is expected that this one factory will soon be producing 864,000 a week, or enough for 24,000 uniforms, since each uniform requires 36 buttons. About 1,200,000,000 buttons are needed for the "utility" suits. Yet despite this production, experts still believe that the American plastics industry will have to supplement British output for the Empire's armies.

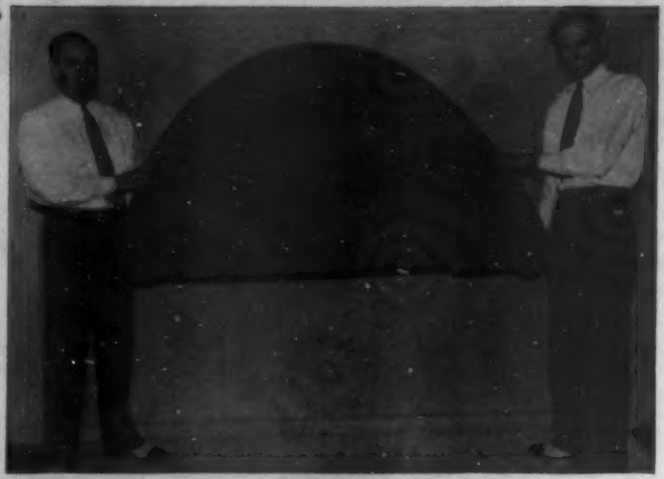


7—Two types of plastic button used by the armed forces: sewing-hole buttons for prosaic purposes of fastening, and shank buttons, which identify the wearer as a Navy or Army man through insignia on their faces

In the long run, plastic shank buttons will have a distinct advantage over brass in that they do not tarnish or corrode. In addition, they have no glint in the sun and are not an attractive object for enemy fire. Tough and durable, they stand up well and have no tendency to crack or peel. The only metal used in them is the shank, and this is molded in and therefore cannot come loose.

It is not very important to the individual soldier that the molded button weighs less than the brass button. What does delight him is its non-tarnishing characteristic. He can now spend more of his training period in learning how to use the weapons of war and less in shining his buttons to satisfy sergeants of the "spit and polish" school.

4



5

4—View of finished wing tip made by the laminated paper plastic process gives an idea of its weight and size. It is composed of only 13 parts whereas, if it were fabricated of aluminum, it would contain 96 separate parts. 5—Preforms for the wing tip are cut to the desired shape and size from the impregnated paper by using a template and a sharp knife. Plies of paper are then loaded in the Kirksite die and molded

Planes of paper

(*Continued from page 82*) structure is assembled. In this experimental assembly, the skin is attached to the ribs by means of bolts. In the production process, however, the internal structure will be bonded to the skin without the use of metal.

This wing tip when tested, as shown in Fig. 3, was found to be stronger than its aluminum counterpart even though the plastic unit was lighter in weight.

With these great savings in strategic materials and fabricating labor, this new paper plastic may be the partial answer to the critical materials shortage which is now facing the aircraft industry of the United Nations, and "planes of paper" may soon be flying in the defense of our own country as well as those of our valiant allies.

Credits—Material developed by Consolidated Water Power & Paper Co. and Forest Products Laboratory of the U. S. Department of Agriculture. Plane parts molded by McDonnell Aircraft Corp.

Repeated flexural stress

(Continued from page 96) way that it will be free from scratches. After machining, all edges of the specimen shall be smoothed to remove burrs.

(*c*) *Drilled-hole notched specimen for thin sheets.* The notched specimen for testing thin sheets[4] shall conform to the dimensions shown in Fig. 4 (*c*). The notch shall consist of a transverse hole drilled with a sharp No. 31 drill, 0.120 in. in diameter. The specimen shall be polished in the region of the hole before the hole is drilled and all burrs shall be removed after drilling. No attempt shall be made to polish the inside of the hole.

Possibilities and limitations of test

5. (*a*) The fatigue test is inherently a time-consuming test and not convenient for acceptance testing. Its primary function is in the evaluation of fatigue strength of materials and determination of data for design.

(*b*) The type of machine covered in this recommended practice is suitable for determining the fatigue strength of both notched and unnotched specimens for any value of mean stress in *tension*.

(*c*) Specimens notched on one side (as in Fig. 4 (*b*)) may be used to determine the notched fatigue strength for any value of mean stress in either tension or compression. It should be mentioned that for material (such as cellulose acetate) which creeps rapidly, the effect of a mean stress other than zero is to cause relaxation so that the stress cycle tends to approach the condition of complete reversal of stress.

(*d*) The notched specimen is used to determine the effect of a notch of standard dimension upon the fatigue strength of the material. The V-notch considered in this test as standard is shown in Fig. 4 (*b*). The transverse-hole notch shown in Fig. 4 (*c*) may be used for thin sheet and material such as plywood for which the continuity of the material would be altered by the V-notch.

(*e*) In any plastic part there are likely to be changes in cross section, such as fillets, holes, screw threads and the like, at which the state of stress is complex (a combination of normal or shearing stresses, or both, in more than one direction) and at which the maximum value of stress is greater than that calculated by formulas such as $S = \frac{Mc}{I}$. It is known that the effect of a certain type of notch in reducing the fatigue strength of one material may be more severe than in another material; the use of a standard V-notch in a fatigue test specimen is therefore desirable as a means of evaluating the sensitivity of a material to the effect of a stress raiser.

(*f*) Other notches have been proposed to replace those shown in Fig. 4 (*b*) and (*c*) but experimental evidence of their suitability is at present lacking.

(*g*) Tests of thin sheet[4] yield results which vary with the thickness of the sheet even though the material is identical.[4] Because of this fact the thickness of the sheet shall be specified when reporting results of tests of thin sheet; and all comparisons of different materials, or selection of materials on the basis of fatigue strength shall be made from results of tests of standard specimens or tests in which the same thickness of sheet is used for all materials.

(*h*) In the application of this test procedure it is assumed that test specimens of a given material are comparable and truly representative of the material. Departure from this assumption may introduce discrepancies as great as, if not greater than, those due to departure from details of procedure outlined in the test.

Conditioning

6. (*a*) *Preconditioning.* All specimens shall be conditioned for 14 days in the atmosphere of the enclosure in which the tests are to be conducted.

(*b*) *Test conditions.* Tests shall be made in a room maintained at a constant temperature of 77° ± 2° F. (25° ± 1.1° C.) and relative humidity of 50 ± 2 percent except when it is desired to evaluate the effect of high or low temperature or relative humidity on the endurance limit. Under all circumstances the temperature and relative humidity of the test atmosphere shall be recorded.

(*c*) *Temperature of specimen.* Since the mechanical properties of many plastics change rapidly with small changes in temperature, and since heat is generated as a result of the rapid flexing of the specimen in fatigue, the air velocity over the specimen shall be known. In order to insure uniformity of test conditions all tests shall be conducted in still air (average air velocity less than 50 ft. per min.). The temperature at the high stress region of the specimen shall be measured and recorded for a specimen operating at the fatigue strength in still air. This temperature shall be measured by means of a thermocouple attached to the specimen by a strip of cellulose tape $^1/_8$ in. in width.

Procedure

7. (*a*) *Calibration of dynamometer.* The dynamometer shall be calibrated occasionally by using a dummy specimen disconnecting the connecting rod at *F*, Fig. 3, hanging known weights from the wrist pin, *F*, and noting the corresponding reading of the dial, *H*. The load in pounds shall then be plotted against the corresponding dial reading. A straight line diagram should result. The load corresponding to one division of the dial may then be calculated from the slope of the line. This value is the calibration constant of the dynamometer. The calibration constant shall give results within 1 percent of the correct value of the load.[5] The dynamometer dial, *H*, shall read zero when a specimen, without grip, *J*, attached, is fastened to the dynamometer at *M*.

(*b*) *Measurements.* The minimum section of the specimen shall be measured to the nearest 0.001 in.[5] (For thin sheet, the relative error of measurement of the thickness of the sheet shall not exceed $^1/_3$ of 1 percent.) The specimen shall be clamped snugly in the grips, *J*, Fig. 2, and the distance, *l*, from the center of the crankpin to the minimum section of the specimen shall be measured to the nearest 0.02 in.[5] The other end of the specimen shall be clamped in the vise and the connecting rod affixed to the wrist pin.

(*c*) *Calculation of stress.* The bending moment shall be calculated as follows;

$$M = S\frac{I}{C}$$

where

M = bending moment,
S = desired stress in tension or compression, in pounds per square inch, on the outer (most highly stressed) fiber of the specimen,
C = distance in inches from the neutral surface to the outer fiber (Note), and

[5] The maximum allowable errors indicated for the measurements and calibration will insure a maximum relative error, in the calculated stress, of less than 3 percent.

I = second moment (moment of inertia) of the net area at the minimum section calculated as follows:

$$I = \frac{bh^3}{12}$$

For the unnotched specimen (Fig. 4 (a)):
b = net width of the specimen, and
h = net depth of the minimum section of the specimen.
For the standard V-notched specimen (Fig. 4 (b)):
b = net width of the specimen, and
h = thickness of the specimen at the root of the notch.
For the drilled-hole notched specimen (Fig. 4 (c)):
b = width of the specimen minus the diameter of the hole, and
h = depth of the specimen.

NOTE. For a rectangular or square cross section (Figs. 4 (*a*) or (*c*)), C = one-half the depth of the beam; for the notched specimen (Fig. 4 (*b*)), C = one-half the thickness of the specimen at the root of the notch.

(*d*) *Calculation of test load.* The load to be applied to the specimen shall then be calculated as follows:

$$P = \frac{M}{l}$$

where
P = load in pounds to be applied to the specimen,
M = bending moment, and
l = distance in inches from the wrist pin to the minimum section of the specimen.

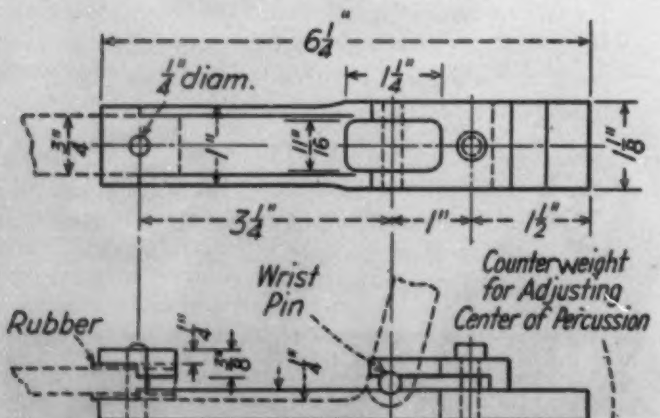
The reading of the dynamometer dial corresponding to this load shall be determined from the dynamometer constant (Paragraph (*a*)).

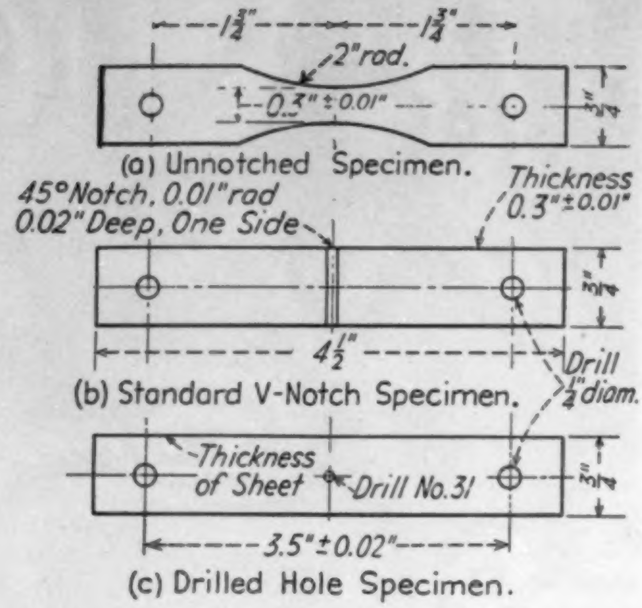
(*e*) *Speed of testing.* The test shall be made at 1720 ± 25 cycles of stress per minute, except when it is desired to determine the effect of speed of testing. The speed of testing shall be recorded.

(*f*) *Adjustments of machine.* To produce complete reversal of stress, the position of the vise shall first be adjusted so that the specimen is undeflected when the variable-throw crank is at mid-stroke. The variable-throw crank shall then be adjusted to produce the load desired on the specimen as indicated by the reading of the dynamometer dial. The load indicated shall be the same for both upward and downward deflection and shall be equal to that calculated in Paragraph (*c*) for the desired stress.

To produce an alternating cycle of stress in which the mean stress is different from zero, the variable-throw crank shall first be adjusted to produce the desired amplitude of the

3—Holder for test specimen





4—Specimens for fatigue test. Note that in the case of unnotched specimens, the thickness of the specimen shall be 0.3 ±0.01 in., except unnotched specimens for sheets, which shall be the thickness of the sheet

alternating cycle of stress and then with the variable-throw crank at mid-stroke the position of the vise shall be adjusted so as to produce a stress equal to the desired mean stress of the cycle.

(*g*) *Readings.* Readings of the dynamometer and revolution counter shall be made before starting the machine.

Dynamometer readings shall be recorded every 12 to 24 hr. during the testing of the specimen. After fracture of each specimen the cross section at fracture and the distance from the fracture to the wrist pin shall be measured and recorded before the specimen is removed from the grips. If the specimen fractures at a section more than 1/4 in. from the minimum section, the data for this specimen shall be marked void. (*Please turn to page 136*)

APPENDIX I.—CLASSIFICATION OF FATIGUE TESTING MACHINES

I. *Direct stress* (tension or compression, or both):
 A. Repeated axial loading by alternating magnetic field or by inertia vibration.
 B. Repeated axial deformation by means of connecting rod or cam.

II. *Flexural stress:*
 A. Repeated loading by:
  (1) Rotating cantilever loaded by weight or spring.
  (2) Fixed cantilever loaded by magnetic or inertia vibrator, or by rotating spring.
  (3) Rotating beam in pure bending loaded by spring or weights.
 B. Repeated deflection by:
  (1) Fixed cantilever, repeated constant-deflection.

III. *Torsional stress:*
 A. Repeated angular torque by:
  (1) Inertia vibrator.
 B. Repeated angular twist by:
  (1) Cam or connecting rod action on a torque arm.

Plotting and interpreting results

8. (*a*) No corrections for the following shall be made to the value of stress calculated at the minimum section of the specimen: (1) for fracture away from the minimum section, (2) for the position of the theoretical maximum stress (see Note, Section 4 (*a*)), or (3) for a change in dynamometer reading during the test.

(*b*) *Plotting results.* An S-N or stress-cycle diagram shall be plotted with the stress as the ordinate against the logarithm of the number of cycles required for fracture as the abscissa. The use of semilogarithmic paper will facilitate the plotting. Specimens which did not fracture shall be indicated on the diagram by an arrow directed away from the plotted point in the direction of increasing cycles.

(*c*) *Interpretation of results.* When a material shows a knee in the S-N or stress-cycle diagram such that the curve gives clear indications that it becomes asymptotic to a horizontal (constant stress) line, it is sufficient to carry the number of cycles far enough beyond the knee to indicate with a good degree of accuracy that the curve becomes asymptotic to a

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APPENDIX II.—SUGGESTED FORM OF DATA SHEET FOR REPEATED FLEXURAL FATIGUE TEST OF PLASTICS

FATIGUE OF PLASTICS

Material.................................... Date.......................................

Fixed-cantilever, repeated-deflection type fatigue testing machine No.............. Test made by..

Specimen:

Width, b....................in. Initial weight...............................g.

Height, h...................in. Final weight................................g.

$\frac{I}{c} = \frac{bh^2}{6} =$ ....in.[3] Specimen temperature...deg. Fahr.

Room temperature................deg. Fahr. Room relative humidity..................percent

Speed of testing..............cycles per minute

Amplitude of alternating stress in cycle......................p.s.i. Mean stress of cycle.....p.s.i.

Moment at minimum section........................in. lb. Arm to minimum section, l.......in.

Load......................lb., or................division on dynamometer

Cross section of specimen at fracture: b.............in., h...............in.

Distance center line of connecting rod pin to fracture, l...............................in.

Final reading revolution counter...

Initial reading revolution counter..

Cycles for fracture......................

Remarks:...

....

APPENDIX III.—SUGGESTED FORM FOR REPORTING RESULTS OF REPEATED FLEXURAL FATIGUE TEST OF PLASTICS

1. For evaluation of the fatigue strength of a material: The report shall contain the following information:
   (*a*) Fatigue strength at................cycles of stress was..........p.s.i. for a mean stress of.... p.s.i. tension or compression (cross out one).
   (*b*) Fatigue ratio was.............
   (*c*) Maximum number of cycles used in the test was..........cycles.
   (*d*) Temperature of the testing room was............deg. Fahr.
   (*e*) Relative humidity of the testing room was..........percent.
   (*f*) Temperature of the specimen when operating at the fatigue strength was.............deg. Fahr.
   (*g*) Conditioning used was ....hr. at ....deg. Fahr. and ....percent relative humidity.
   (*h*) The type of testing machine was ....
   (*i*) The speed (number of cycles per minute) of the testing machine was ....
   (*j*) Description of material tested is: name ...., manufacturer ...., code number ...., date of manufacture ...., type of molding ...., thickness of sample ....
   (*k*) The dates of test were ....
2. For evaluation of the fatigue strength of a notched material: The report shall contain items 1 (*b*) through (*k*) above, and:
   Fatigue strength at ....cycles of stress of a standard V-notch specimen was .... psi. for a mean stress of ....psi. tension or compression (cross out one).
3. For evaluation of the fatigue strength of thin sheet[4]: The report shall contain items 1 (*b*) through (*k*) above, and:
   Fatigue strength at............cycles of stress of a sheet of..........in. thickness was........ psi. for a mean stress of............p.s.i. tension or compression (cross out one).
4. For evaluation of the fatigue strength of notched thin sheet: The report shall contain items 1 (*b*) through (*k*) above, and:
   Fatigue strength at............cycles of stress of a sheet of............in. thickness with a drilled-hole notch was..........p.s.i. for mean stress of..........p.s.i. tension or compression (cross out one).

constant stress line. If the curve does not become asymptotic to a constant stress line, the test shall be continued until the number of cycles reached is greater than the number of cycles that the material will be expected to withstand in its life. The value of stress corresponding to this number of cycles shall be reported as the "fatigue strength at . . . cycles." (Substitute the maximum number of cycles for which the stress-cycle diagram has been well defined by the tests.)

Precautions necessary in applying results

9. (*a*) So little is known about the relationship between service and fatigue tests of plastics that generous factors of safety should be used in design.

(*b*) It is necessary to make sure whether it is failure from fatigue that is the prime danger or failure from other causes such as creep, yielding, fracture under a single loading, or others.

(*c*) For plastics which are subject to creep at the temperature of testing (this probably includes all plastics at room temperature) a fatigue test, in which the mean stress is not zero, is accompanied by either creep or relaxation depending on the type of testing machine used. Relaxation of stress will occur for the type of machine considered in this method. As a result of this relaxation the range of stress tends to approach the condition of complete reversal of stress as time goes on. The magnitude of the effect that relaxation would have on the result obtained will depend upon the rate at which relaxation takes place and upon the time required for the endurance limit to be reached. The rate at which relaxation takes place will depend upon the material and the magnitude of the mean stress of the cycle.

Report

10. The report (see Appendix II) shall include the following:

1. Description of the material tested including name, manufacturer, code number, date of manufacture, type of molding, and thickness of specimen or original material in case of thin sheet.
2. Dates of the test.
3. Type of testing machine.
4. Size and type of specimen used and whether notched or unnotched. If notched, the type of notch.
5. Thickness of the specimen in the case of thin sheets.
6. Preconditioning used (number of hours at the temperature in degrees Fahrenheit and relative humidity).
7. Temperature of the testing room in degrees Fahrenheit and the relative humidity of the testing room.
8. Temperature of the specimen in degrees Fahrenheit when operating at the fatigue strength.
9. Speed (number of cycles per minute) of the testing machine.
10. Fatigue ratio.
11. Maximum number of cycles used in the test.
12. Fatigue strength in pounds per square inch at the number of cycles of stress, and the mean stress.
13. Mean stress of the cycle in pounds per square inch and whether in tension or compression.

Forming & repairing acrylics

(*Continued from page 89*) should not be used. The pressures thus developed would be far in excess of those required, and no matter how good the surfaces of the dies, poor optical properties will usually result.

Repairing and patching acrylics

Just as forming is one of the most important procedures in the production of acrylic airplane sections, so proper repairing and patching is one of the most important procedures in the maintenance of these sections. Included below are methods for making repairs under field conditions. They are at best makeshifts and should not be regarded in any other light. When adequate facilities are available, replacing the part is more advisable than attempting a repair. In general, it will be found more practical to buff any scratched sections, but patching may not be justified except on large and complicated formed sections.

Mending cracks

At the first sign of cracking, a hole $^1/_8$ in. to $^3/_{16}$ in. in diameter should be drilled at the end of the crack. This simple operation helps to prevent further splitting by distributing the strain over a larger area.

It is also possible to relieve this strain, in the case of long cracks, by lacing the crack with wire. A series of holes should be drilled along either side of the crack but at least $^1/_2$ in. away from it. Use a strong flexible wire such as aerial wire. This will not seriously interfere with vision and will usually suffice until better repair facilities are available or until a replacement can be made.

Bullet holes

The first step in repairing bullet holes in acrylic sections is to drill holes at the end of each radial crack or to trim the hole and surrounding cracks to a circle as soon as possible. This will prevent the development of radial cracks and will confine the damage to a minimum area.

As an emergency, the hole can be quickly patched with thin methyl methacrylate or cellulose acetate sheeting applied to both surfaces with a solvent. Acetone, glacial acetic acid, ethylene dichloride and lacquer thinners will serve to soften the surface so that a satisfactory bond between the patch and the original section may be obtained. By dissolving a few acrylic chips in ethylene dichloride, glacial acetic acid or monomeric methyl methacrylate, an especially good viscous cement may be obtained. In any case, cut the plastic patch to size, preferably rounding off any sharp corners. When the damaged section is curved, the patch should be formed to fit. The section itself may be used as a form for the patch simply by protecting it with outing flannel or similar soft cloth.

Next, hold the patch in position and mark around it lightly with a pointed scribe or crayon. Apply tape along these lines to protect the surrounding plastic surface from the etching action of the cements or solvents. In an emergency, almost any tape may be used such as adhesive, electrical, cellophane or painter's masking tape. If several types are available, determine the most satisfactory by seeing which is most resistant to the action of the solvent.

If ethylene dichloride, acetone or a lacquer thinner is used as a cement, it is also necessary to mask one side of the patch. After masking, the patch is immersed in the solvent until the unmasked surface is softened to a depth of approximately

$^1/_{32}$ in. It is then placed carefully in position and held in place by hand or with suitable spring clamps or jigs until hard. Too much pressure should not be applied to the patch—just enough to force any entrapped air bubbles out of the joint.

If one of the viscous cements referred to above is used, it is not necessary to mask the patch. The cement is spread over one of the two surfaces to be joined and the patch held in place until the cement "sets" enough to hold the patch securely.

The masking around the patch is removed after about 30 minutes to remove any excess cement. This simple step will make for a much neater patch.

An even quicker patch can be made by patching with wing fabric. By dipping the fabric in acetate dope, or coating both sides with dope, the fabric can be made to adhere well to the plastic. A more effective bond, however, may be obtained by soaking the patch in ethylene dichloride, acetic acid or acetone. The objection to all fabric patches, of course, is that the fabric is opaque and will cause a blind spot in the plastic section.

In all emergency repairs, the conditions and available facilities will determine the type of repair to be made. The fact that repairs can be made, however, is another convincing argument for the use of acrylic plastics in combat aircraft.

Weight saving in gages

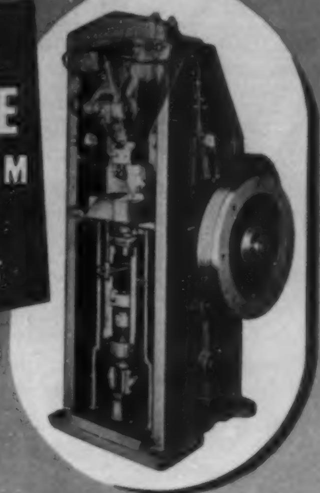
(***Continued from page 85***) flange and the top edge of the case was proposed. The design was improved further and drawings were made of a double-walled case construction, the outer wall being conical and the inner wall straight, and the two tied together by a series of strengthening ties.

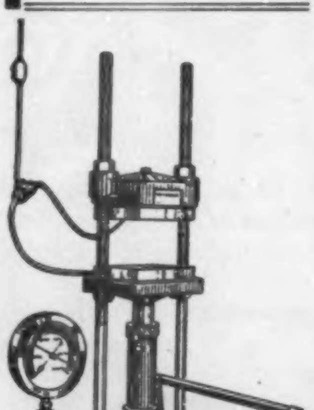
Meanwhile, the Navy Department engineering staff sent out special tentative drawings of a redesigned casing to all gage manufacturers, asking for their comments and reactions. The net result was that the truncated cone case was adopted and is now the Navy standard with one additional refinement.

The chief advantage of the old phenol case was the reduction in weight, but because of its weakness it was not fully accepted by industrial users. Now that the new phenol case has been redesigned to make its strength entirely adequate for all applications, there is no reason why it should not entirely replace the use of cast metal gage casings. It has all the strength advantages of cast metal cases, plus all the additional advantages—such as lightness, superior finish, superior corrosive resistance, etc.—that only plastics can afford.

The old style phenolic case and ring had a tendency to reflect light from their highly polished surfaces. This was objectionable and was overcome by sand blasting the outside surface of the new cone design case. The molding industry, experimenting with methods of obtaining this finish without sand blasting the piece, finally evolved the process of sand blasting the mold surface itself. After several hundred pieces had been molded, it was found that this sand blasted surface started to wear from the mold, but this difficulty was overcome by chrome plating the sand-blasted mold surface. Since that process was adopted, the sand-blasted mold surface has successfully withstood the abrasive action which is inherent in the molding of all phenolic materials.

Tests conducted by the Navy show that this final design (Fig. 3) answers every objection offered to the old phenolic case and ring design. (*Please turn to page 142*)





During the present emergency, not only is the weight-saving factor important, but the use of plastic material saves strategic metals such as brass, copper and steel. For one gage company alone the approximate saving of such metals is about 60 tons per year, and this figure is increased at least 10 times when all other companies making gages are considered. Furthermore, these figures are being amplified daily as more and more users of gages and instruments are modifying their specifications to permit use of phenolic cases instead of cases of metal.

As one example of weight saving, it may be said that on an average battleship there are approximately 1000 gages which would make a total weight saving of over 3000 pounds. While this figure is insignificant when the total weight of the modern battleship (from 26,000 to 45,000 tons) is considered, it is highly important as only one item among hundreds aboard ship which have been engineered and designed for weight saving.

Design fundamentals

(*Continued from page 78*) of the flashed material will take place and produce an excessive flash thickness resulting in oversize for the molded part.

Group 3, filler plate molds, are a modification of flash and compression molds The filler plate serves as a ring permitting loading of the mold without preforming, just as in a compression mold, and at the same time flashing off the excess material as in a flash mold. The same design considerations must be given to the filler plate as to the lands in flash molds.

Group 4, transfer molds, are a more recent development of molding technique. The principle of this molding is to preheat the material in a pressure chamber and move the softened plastics under high pressure through a gate into the mold cavities. This type of molding is not very satisfactory when using macerated canvas-base materials.

A careful study of the part to be molded is necessary for the selection of the proper mold. A wood or plaster model of the part to be formed very often more than compensates for the expense involved. It is much easier to change a plaster model than a hardened steel mold. When designing molded parts there are a few "musts" that should be observed.

A. Avoid all sharp corners and employ fillets wherever possible to do so (Fig. 4).

B. A uniform cross section is ideal, but very seldom possible. When different wall thicknesses are required in the same part, sudden change from one thickness to the other should be avoided (Fig. 3).

C. Sides should be designed with a 1° to 3° draft to help removal of piece from mold (Fig. 3).

D. Do not design for undercuts (Fig. 3).

E. Large, thin sections should be strengthened by rib construction, which will also reduce warpage (Fig. 7).

F. If inserts are to be molded into the piece, use diamond or square knurls, but do not use straight keying or splining. A straight spline will prevent turning, but will not prevent pulling out (Fig. 5).

G. Design with sufficient plastic around inserts to prevent cracking of material caused by the different shrinkage characteristics (Fig. 6).

H. Molded threads should be avoided. If threads are necessary, they should be machined. (*Please turn to page 144*)

The foregoing are the most common pitfalls encountered when changing over from light metals to plastics. A careful consideration of the foregoing suggestions will be a great help toward successful molded plastic design.

The next consideration in design is the tolerances that can be maintained on molded parts. There are a number of factors which will influence the final dimensions of a molded piece, such as wear and distortion of molds, slight variations in raw material make-up and weights and shrinkage of molded pieces after stripping from the mold. A commercial tolerance of ±.015 in. in 1 in. thickness and 5 in. diameter is considered as a good average, with wider tolerances required as the size of the molded part is increased.

Molded parts are, however, readily machined in standard shop equipment. With special care, machined surfaces can be held to tolerances as close as ±.0015 inch.

The molding pressures used are important in selecting the material for the molds. High-pressure molding demands steel, which must be hardened to insure a reasonable number of molding cycles. Here the plastic manufacturers themselves are becoming the victims of critical metal bottlenecks. There is a considerable amount of work being done on low-pressure molding. Different schools of thought are exploring different paths to reach the solution to the problem of an ever increasing demand for plastics, which in many instances have proved superior to the materials they replace.

Fountain fixtures

(*Continued from page 58*) delivery could be secured. Each plastic faucet, the Quartermaster Corps figured, would release some eight ounces of brass and weigh only half as much itself.

Again the manufacturer and the molder put their heads together. Out of the huddle came the faucet shown at the lower left of Fig. 1. With the exception of the coil spring and a tiny insert in the push button, the new unit contained no metal. A brief spout was added to make the dispenser more businesslike.

The faucet is compression molded in four parts. The entire body is molded in one piece in a split mold with threaded side cores which are withdrawn with the piece when it is taken from the mold, unscrewed, and replaced for the molding of the next unit. The push button has a molded thread and molded-in insert. Both the plug and the body are pipe-threaded. Although the first faucets supplied to the QMC had metal shafts attached to their valve buttons, later models will have button and shaft molded together in a single piece.

The tough, durable phenolic material of which the faucet is molded will take lots of hard knocks, and will resist water and the sterilizing reagents used to purify the water. It has the property of being able to shrink around metal inserts, thus holding them tightly in place.

The faucet is constructed so that its valve is well protected from damage, and the slightest pressure of the finger causes an immediate and steady flow of water. There are no rough surfaces to collect sediment, no parts that will rust and flake off in the water, and the interior of the unit is as smooth as glass. Faucets are easily taken apart and reassembled without the use of special tools. Taxpayers will be pleased to know that plastics faucets cost less than brass faucets.

Credits—Material: Bakelite. Molded by Boonton Molding Co for Cordley & Hayes. Faucet designed by J. B. Frederico.

Lights that save lives

(*Continued from page 53*) the light and the ocean floor.

The manufacturer says that his light is completely waterproof and will continue to burn when totally submerged. He states further that when, in a series of tests conducted by the company, the inside of the unit was filled with water and it was then immersed, even this exhaustive dunking had no effect on the illuminative efficiency of the light. Tests for strength of the plastic materials of which the article is molded showed that they would stand up under far rougher handling than they were likely to receive. Under actual conditions of use, the polystyrene was unaffected by extremes of tropical heat and arctic cold.

Both the body of the flashlight and its cap are injection molded in one piece. One molding company uses fully automatic molds for both parts. The rotating cores which form the inside and outside threads unscrew automatically, and there are no plates which must be removed manually before the pieces are taken from the mold. Early this year the flashlight received final approval from the Merchant Marine Inspection Section of the U. S. Coast Guard. More than 150,000 of the lights are now in service on vessels of the Merchant Marine, helping to cut down loss of life when disaster strikes in the course of this grim business of war.

Credits—Flashlights molded by Injection Molding Corp. and Columbia Protektosite Co., Inc., for Colvin-Slocum Boats, Inc.

Acid and alkali resistance

(*Continued from page 94*) hydroxide solution. It will be observed in Fig. 5 that the final strength of cellulose acetate indicated complete attack in all instances, though the effect of conditioning is shown in the length of time required for the degradation to take place. Other plastic materials less susceptible to moisture than cellulose acetate were less dependent upon previous conditioning. In general, the drier a sample of plastic material, the less readily it will be attacked by acids and alkalies.

Effect of solution concentration: One of the most interesting results observed in this series of tests was the fact that there is a certain range of concentrations of sodium hydroxide that is particularly active upon plastics. This range is around a 5 N solution as indicated in Fig. 6. Concentrations of sodium hydroxide above this range have less effect upon the plastics.

With respect to the acids, the strongest concentrations brought about the most destructive results. However, there is some evidence in the case of sulfuric acid that a condition exists similar to that observed for sodium hydroxide. It will be noted that for most of the materials tested, the 1.06 N solution of sulfuric acid was more active than the 4.3 N or the 11.05 N solution. However, the maximum available commercial concentration of 34.6 normality was very much more active than any of the lesser concentrations.

Effect of filler: In the case of phenolic plastics particularly, the effect of the acid or alkali is determined not only by the synthetic resin but also by the base material serving as the reinforcement. Thus, for example, it is obvious in Fig. 7 that the phenolic resin is the portion attacked, since the glass base is known to be resistant to these chemicals. Comparison of these data with the results for the laminated phenolic

plastic material with paper base reveals that the laminated plastic made with a glass base possesses considerably better chemical resistance.

Conclusions

By means of these tests it is possible to arrive at some quantitative comparison between the various acids and their effect upon plastic materials. For example, looking at the curves for cellulose acetate, it may be definitely concluded that nitric acid is more active than hydrochloric acid, which in turn is more active than sulfuric acid. Likewise the relative effect upon various plastics may be noted.

It may be concluded also that a quantitative determination of the effect of corrosive agents upon plastics may effectively be carried out through an examination of changes taking place in some physical property of the material upon prolonged periods of immersion.

Sealing jars, modern style

(Continued from page 72) mixers or other mixing mills familiar to the rubber and plastics industries. The material is then either calendered into sheets from which the closure may be die cut, or extruded in the form of tubes and the rings sliced off on regular cutting machinery. Whether the material is extruded or calendered depends on the width of the ring desired, the extruded form being used for the narrower widths.

Because of the pressure of its war work, the company's capacity for producing the sealing material will be limited to about 3,000,000 pounds annually. However, Lloyd H. Diehl, president of the company, says he intends making the process available to other responsible manufacturers to insure a sufficient supply of this food-packing necessity.

"Our interest in this new product is based on our Government's need for rubber conservation," says Mr. Diehl. "We will be glad to make it available under mutually satisfactory arrangements to any reputable food packer or container maker. Our main job is to help keep those adversely affected by the rubber situation 'in production' for the sake of our national economy."

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Toxicity	none, based on all tests to date
Resilience	good
Low temperature resistance	satisfactory
Light resistance	good
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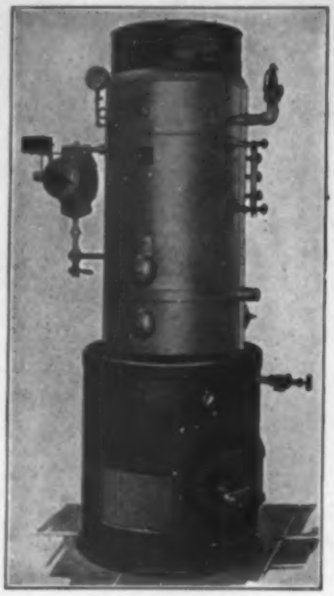

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to the new material with very minor adjustments to his existing equipment, it is said. Furthermore, many types of general-purpose machinery can be readily employed in the simple process. Any extrusion machinery capable of extruding tubes of the diameter of a standard jar opening can be used.

Floating on air

(*Continued from page 70*) worn by a 200-lb. man who strikes the water after a 55-ft. jump.

The resiliency of the Cellophane bubbles, a property which stems from the springiness of the entrapped air, suggests the potential use of this material as a shock-absorbing replacement of sponge or "cellular" rubber, which is so scarce today. These air bubbles in combination with an adhesive material have been formed into mats and cushions which may find their way into padding for planes and tanks. The effect of bullets on these cushions and mats has been merely to leave a small hole where the bullet struck, and the essential utility of the items remained unchanged.

One of the outstanding properties characteristic of the material is its low thermal conductivity or excellent insulating properties, attained because air, which is a good insulator, is one of its chief ingredients. The material, therefore, which is essentially an aggregation of air cells, can be used not only as stuffing, but as an insulating layer. Experimental fabrics have been woven with cotton threads running in one direction, and strands of this material in the other, and the result was an extremely lightweight cloth suitable for use as an interlining in cold weather jackets and flying suits, or several layers combined to make a sleeping bag filler.

When the war is over and production for civilian use resumed, we may all be sleeping on air—air, hygienically packaged in minute Cellophane parcels.

Credits—Material: Bubblfil, developed by E. I. du Pont de Nemours & Co., Inc.

Modern designs

(*Continued from page 65*) equipment, and one of the most interesting projects recently executed at the school was provoked by a competition sponsored by the Chicago Chapter of the American Designers' Institute for a redesigned traffic light (see Fig. 4). The first prize was captured by a student at the School of Design in Chicago for a design which features a column in which fluorescent lighting, neon lighting or methyl methacrylate edge lighting is employed individually or in combination one with the other. The design provides for an arrangement whereby the green "go" signal strips are placed vertically, and the red "stop" strips horizontally, making it possible even for a colorblind person to tell the signals apart from their direction, rather than from their color.

Another feature of this traffic light control is that without light it is entirely colorless, signalizing only the required parts of the column with colored light. In this way, incorrect reading of light, frequently caused when the sunlight strikes colored glass covers of conventional traffic lights, can be avoided. (*Please turn to page 152*)

The all-plastic motor car pioneered by the Ford Motor Co. has already been projected in an even more stream-lined version by students at the school (Figs. 9, 10). This design for an all-plastic automobile features invisible bumpers, pneumatic springs, rear engine, balanced drive, automatic shifting center of gravity, fluid drive, doughnut nitrogen wheels. The plastic walls are stabilized and strengthened through appropriate integral curvature without a skeleton construction, and the whole represents the ultimate in automotive modernity.

After this holocaust is over and the war won, there will inevitably follow a period of reconstruction and change. It seems like a fairly safe prediction that in the front ranks of builders of the future will be the young designers and craftsmen who are being trained today to work with the prime building materials of tomorrow, notably plastics.

Note: The designs shown in this article are fully copyrighted or patents applied for, and are available to interested parties on a royalty basis, except for the wood springs for which the School has already received a contract. All work shown in photographs was designed in the School of Design in Chicago.

Publications

(Continued from page 110)

★ THE PROBLEM OF INCREASING NUMBERS OF young, untrained workers with limited information about machine-tool operation is being met by Continental Machines, Inc., Minneapolis, Minn., by the distribution of their Doall Library to users of their machinery. This library is enclosed with every sawing and filing machine sold by this company, and contains information which key departments of industrial plants would require in order to get effective and efficient operation from the users of these machines. Different booklets go to the purchasing, engineering and plant superintendent departments, which are the three departments normally concerned with maintaining operation for any machine tools.

★ A 47-PAGE CATALOG, 95-A, HAS JUST BEEN ISSUED by the Foxboro Co., Foxboro, Mass., on industrial instruments available from this company. Photographs are accompanied by brief descriptions of the operation and function of each of the instruments in the line.

★ A CATALOG OF INDUSTRIAL OR MANUFACTURING uses of fir plywood and a handbook of plywood technical data for engineers and architects have just been published by the Douglas Fir Plywood Association, Tacoma, Washington, in an effort to keep pace with the growing demand for information about the properties and characteristics of this material.

The industrial book is a collection of selected articles telling of new commercial (non-construction) plywood applications for building barrels, boxes, crates, railroad cars, signs, etc.

The technical handbook, edited by N. S. Perkins, is divided into three sections: physical characteristics of plywood, designing with plywood, and prevention of condensation in walls. This booklet is supplemented with tables, charts and diagrams useful to engineers and architects who are working increasingly with this important new material.

★ BULLETIN 1004 DESCRIBING THE NEW TURRET lathes available from the South Bend Lathe Works, South Bend, Indiana, has recently been issued by the manufacturer. The four-page bulletin describes and illustrates the new models and tabulated specifications list information concerning capacity, feeds, speeds, and dimensions of the machinery.

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WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE: 1—W.S. Hydro-Pneumatic Accumulator 2500 PSI, 8 gal., with IR m.d. compressor; 1—Hydro-Pneumatic Accumulator, 2500 PSI, 16½ gals., complete with tank, compressor and piping; 1—W.S. 13" x 18" Hydraulic Press, 10" dia. ram, 4" posts; 1—Triplex Hydraulic Pump, 11 g.p.m. at 2000# pressure, also others; 1—W.S. Hand Pump; 1—set of Compounding Rolls 18" x 44"; Adamson 6" Tuber; 7—W. & P. Mixers; Dry Mixers, Pulverizers, Grinders, etc. Send for complete list. Reply Box 446, Modern Plastics.

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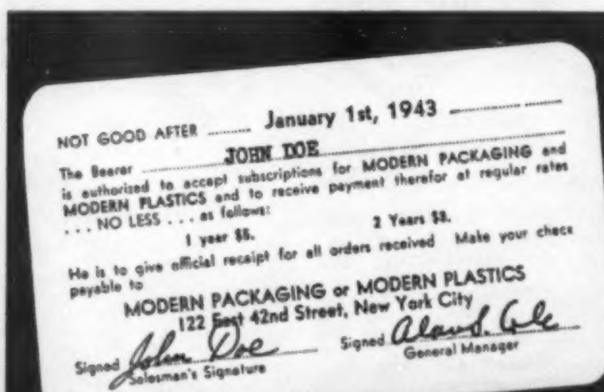

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WANTED

Established Midwest company opening plastic division requires experienced executive capable of setting up and operating this division. Must have practical experience in tool and mold design, construction and operation, also complete knowledge of plastics, molding practice and machines. State experience and accomplishments completely, giving age, education, military status and salary expected. Reply Box 668, Modern Plastics.

FOR SALE: Hydraulic Press—8 openings, each 3", 30" x 52" x 2" steel steam platens, 2—14" dia. x 23" stroke rams, with pump, motor, valves, piping, fittings, etc., forming complete unit. Excellent condition. Hydraulic Plastics Sheeter, capacity 24" x 5' sheets, complete and in good operating condition. Also other presses, varying sizes and capacities, pumps, accumulators, grinders, tumbling barrels, preform machines, boilers, motors, etc. Industrial Equipment Company, 876 Broad Street, Newark, N. J.

WANTED: We have Government permit to buy acrylic scrap resulting from compression and injection molding. Highest price paid. Submit samples to Peters Chemical Mfg. Co., 3623 Lake St., Melrose Park, Ill.

WANTED: Connection Sales Representative with irreproachable manufacturer dealing with jobbers exclusively. Will resign executive position in Government War Agency. Wide knowledge Government problems. Consider Southern U. S. and D. C. Seventeen years as sales and advertising manager. Personal contacts with jobbers throughout nation. Write for brochure of business history and references. Reply Box 663, Modern Plastics.

POSITION DESIRED AS PRESSROOM FOREMAN by man with years of thermosetting and thermoplastic molding experience. Experienced in handling help. Would prefer a position in or near Boston, but will go anywhere. Immediately available. Favorable draft classification, and references. Reply Box 665, Modern Plastics.

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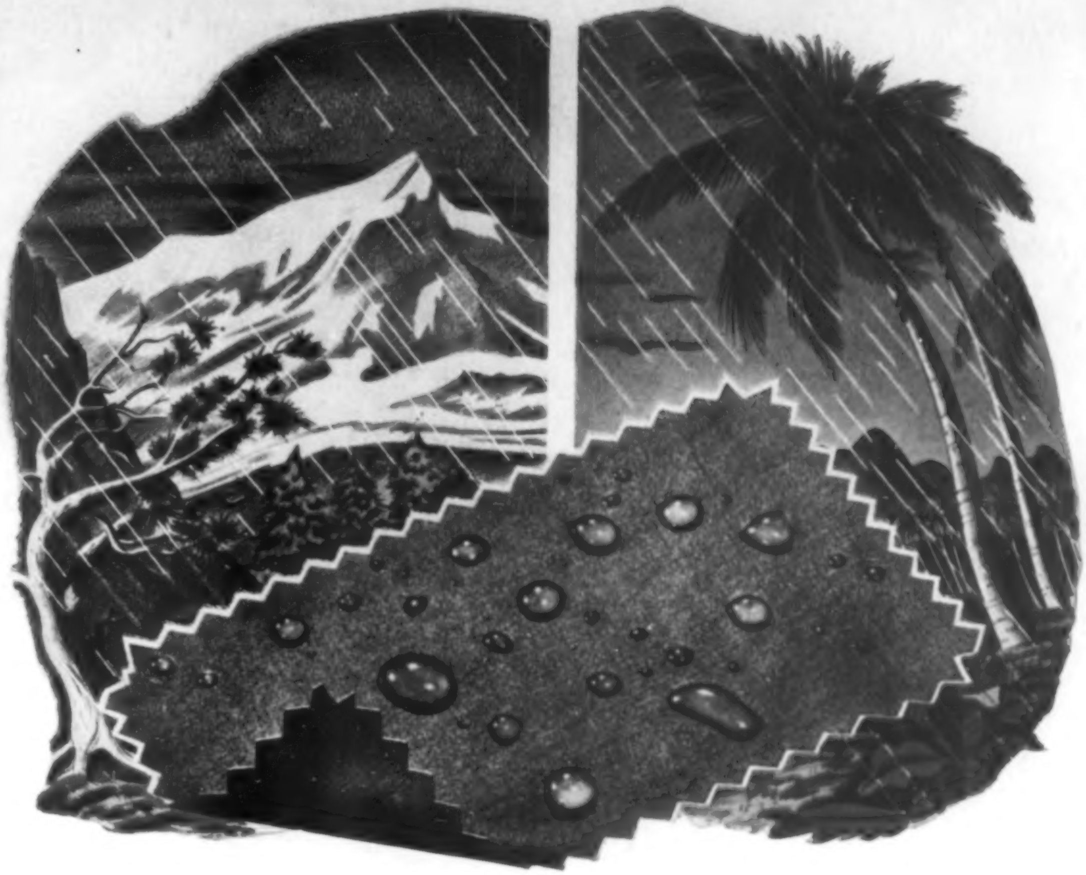

WATERPROOF-ARMOR *for cotton cloth*

withstands heat, cold, flexing, and aging . . .

Can these VINYLITE Plastics' Properties help you solve a problem?

In the past, "waterproof cloth" often meant a coated or treated fabric that developed a disagreeable odor wher wet, became brittle when cold, or sticky when hot. As a result, there has long been a demand for a more satisfactory waterproof cloth.

To meet this demand, the Plastics Division of Carbide and Carbon Chemicals Corporation has been carrying on an intensive research program, and there is now available a superior cloth coating based on VINYLITE Resins. The properties of these resins make them especially suitable for this type of application. Unlike most plastic materials, they can be plasticized to yield tough, flexible coatings that remain pliable over a wide temperature range. They are highly resistant to water and a broad range of corrosive chemicals. They do not crack nor become brittle upon aging. They are applied to the cloth by calendering or spreading.

VINYLITE Plastic surface coatings have been developed not only for cloth, but for metal, paper, leather, concrete, and ceramics. There are types so tough that steel sheets coated with them can be crimped, spun, punched, or drawn without damaging the protective resin film. Others provide durable stop-off lacquers that withstand the hot acids of electroplating baths. Still others replace tin and other corrosion-resistant linings for food cans and chemical processing tanks.

In common with other types of VINYLITE Plastics, the wartime demand for these superior coatings has increasingly limited their use for commercial purposes. However, if you are engaged in war production, and are searching for materials with the unique combination of properties offered by VINYLITE Plastics, we suggest that you enlist the full co-operation of our technical staff.

Plastics Division

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 EAST 42ND STREET, NEW YORK, N.Y.

Vinylite*

PLASTICS

Rigid Sheets • Flexible Sheeting and Film • Adhesives
Molding and Extrusion Compounds • Resins for Surface Coatings

**The word "Vinylite" is a registered trade-mark of Carbide and Carbon Chemicals Corporation*